JAN 28 1930

AMERICAN JOURNAL of PHARMACY

SINCE 1825

A Record of the Progress of Pharmacy and the Allied Sciences

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Price $3.00 per Annum in Advance — Foreign Postage, 25 Cents Extra

Single Numbers, 30 Cents. Back Numbers, 50 Cents

Entered as Second-Class Matter at the Post Office at Philadelphia, Pa., Under the Act of March 3, 1879

Acceptance for Mailing at Special Rate of Postage Provided for in Section 1103, Act of October 3, 1917. Authorized February 15, 1920

PUBLISHED MONTHLY BY THE

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THE AMERICAN
JOURNAL OF PHARMACY

VOL. 102 JANUARY, 1930 NO. 1

EDITORIAL

IN NINETEEN TWENTY-NINE

THE PHILOSOPHER'S STONE continues a silly dream—and the Elixir of Life still stays at the foot of the rainbow. In spite of split atoms and orbits—in spite of the bridling of radium—neither silver nor gold is yet begotten of lead.

Empires and thrones have tumbled to the tune of time—kings and queens and all their glory have passed with the steady tread of history—yet in the realm of metals, silver and gold continue to reign.

Youth is still happy with morning, but darkness comes with the evening of life. Rejuvenation is yet a talking word and Death still rides his scurvied nag.

But though transmutation and rejuvenation have baffled the ken of men of science, they still carry on, and in the year just past, in air, under sea, and on the surface of the earth, their searchings into the mysteries of the universe have vastly progressed.

The earth was circumnavigated by airship for the first time. Airplanes flew in the antarctic, one of them reaching the South Pole. The depths of the sea yielded new secrets. Telescopes reached farther and more searchingly into the depths of the universe. Less spectacular but perhaps more important to posterity were investigations on life, chemistry, and the constitution of matter, conducted in quiet laboratories.

Some of the most important and most interesting advances in these fields during 1929, as included in a copyrighted article by *Science Service*,* are as follows:

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Medicine and Pharmacy

A poisonous sugar, the only sugar known that has a toxic reaction, was discovered in tuberculosis bacilli by Dr. R. J. Anderson, Yale University chemist.

A lifeless compound, extracted from mass cultures of tuberculosis germs, produced bodily changes like those of tuberculosis in experiments conducted by Drs. Florence R. Sabin, Charles A. Doan and C. E. Forkner, of the Rockefeller Institute for Medical Research.

Dried hog stomachs were discovered by Drs. C. C. Sturgis and Raphael Isaacs, of the University of Michigan, and Dr. E. A. Sharp, of Parke, Davis & Company, to have the same effect in the treatment of pernicious anæmia as the raw liver now widely used.

The Imperial Cancer Research Fund reported that they could find no connection between malignant growths and dietetic deficiencies.

An explosion at the Cleveland Clinic caused the death of a number of patients by nitrous oxide from stored photographic negatives; and in consequence, hospitals and clinics all over the country took steps to eliminate the hazard in stored X-ray negatives and regulatory legislation covering this matter was initiated in various cities and States.

A young woman physiologist with the unique respiration rate of three to four times a minute, instead of the usual fifteen to eighteen times a minute, was studied by Dr. Francis G. Benedict, of the Nutrition Laboratory of the Carnegie Institution of Washington, at Boston.

Pepsin, the digestive enzyme, was crystallized and isolated by Dr. J. H. Northrop, of the Rockefeller Institute for Medical Research laboratories, at Princeton, N. J.

Progress in studying and photographing in motion pictures the growth progress of cells and mammalian eggs was continued by the Department of Embryology of the Carnegie Institution of Washington at Johns Hopkins University in Baltimore.

Only six of the forty species of Anopheles mosquitoes are important as carriers of malaria, Prof. Francis Metcalf Root, of Johns Hopkins University, discovered.

Prof. John J. Abel, who was the first to isolate pure crystalline insulin, made the discovery that only a part of the complex insulin molecule is necessary to combat diabetes.

That liver contains a substance which will reduce the concentration of sugar in the blood, as insulin does, was reported by Drs. Harry

Blotner and W. P. Murphy, of the Peter Bent Brigham Hospital, Boston.

Surgical control of Raynaud's disease was apparently attained by Dr. A. W. Adson and Dr. G. E. Brown, of the Mayo Clinic.

During the winter of 1928-1929 there occurred an epidemic of influenza which, though mild as compared with the epidemic of 1920 and the pandemic of 1918-1919, reached most of the countries for which mortality statistics are available.

An abnormally large number of cases of cerebrospinal meningitis occurred in the United States; the outbreak was traced to an origin in the Orient.

An outbreak of smallpox occasioned considerable alarm in England during the spring.

The work on the regular decennial revision of the U. S. Pharmacopœia was begun.

Dr. Oliver Kamm, research director of Parke, Davis & Company, was awarded a prize of $1000 by the American Association for the Advancement of Science for his research in isolating the hormones of the pituitary gland.

The Nobel prize in medicine for 1929 was awarded to Prof. Christian Eijkman, of the University of Utrecht, and to Sir Frederick Gowland Hopkins, of the University of Cambridge, for their researches on the vitamins.

Plans were made, committees formed and work begun on "the most sweeping study of child welfare that has ever been made in all the world," the results of which will be presented at the White House Conference on Child Health and Protection in 1930.

Dr. Joseph Goldberger, discoverer of the cause, cure and means of prevention of pellagra, died on January 17. His widow was granted a pension of $125 per month by Congress.

Mme. Marie Curie, co-discoverer of radium, visited America to attend scientific functions and to receive a gift for the purchase of a gram of radium for the Warsaw Cancer Hospital.

The International Society for the Prevention of Blindness was formed at a conference at The Hague in September.

A department of the history of medicine, the first one in this country, and the allied William H. Welch Medical Library were dedicated at the Johns Hopkins University.

The Wilmer Ophthalmological Institute of the Johns Hopkins University, the only such center in the country having its own building

for treatment, research and teaching in diseases of the eye, was dedicated at Baltimore.

The narcotics division of the U. S. Public Health Service was established in February.

Report was made by Dr. Isadore S. Falk, of the University of Chicago, that he had isolated a group of micro-organisms that he believes were the causative agents of influenza during the 1928-1929 epidemic.

A method of immunizing dogs against distemper by double inoculation was developed by Drs. P. P. Laidlaw and G. W. Dunkin, of London.

Physics

The Nobel prize in physics for 1928 was awarded to Prof. O. W. Richardson, of King's College, London, for his researches in the branch of physics which he christened "thermionics". The 1929 physics prize was awarded Prince Louis Victor de Broglie, of Paris, for his studies in wave mechanics.

Artificial lightning of 5,000,000 volts was produced in the experimental lightning laboratory of the General Electric Company at Pittsfield, Mass., by F. W. Peek, consulting engineer.

A new kind of structure within the crystals of metals and other substances, intermediate between the molecule and the crystal structure, was postulated theoretically by Dr. Fritz Zwicky, of the California Instiute of Technology, and verified experimentally by Dr. Alexander Goetz, of the same institution.

Cosmic rays from outer space twice as penetrating and half as short as those previously discovered were announced by Dr. R. A. Millikan, of the California Institute of Technology.

Prof. A. S. Eddington, astronomer at Cambridge University, developed a theoretical formula for the charge of the electron, which is expected to have important results.

Albert Einstein brought out his "Unified Field Theory."

Preliminary work was started on a trans-Atlantic cable to carry telephone messages, as a supplement to the radio telephone service. This is made possible by a new cobalt steel alloy called "perminvar" and a new insulating material called "paragutta," both developed by the Bell Telephone Laboratories.

Photoelectric cells were used for measuring colors in the way they will affect the human eye by Dr. Clayton H. Sharp, of the Electric Test Laboratories in New York.

A clock of extreme accuracy was developed by Dr. W. A. Marrison, of the Bell Telephone Laboratories; it uses an electrically driven vibrating quartz crystal instead of the conventional pendulum for regulating its motion.

The broadcasting of weather maps by the Fultograph process was begun in Europe.

Motion picture film twice the ordinary width, making possible a screen picture the full width of an ordinary stage without loss of detail, was introduced by the Fox Film Company. Several other producers were experimenting with similar film.

A special research laboratory for the study of sound motion picture problems was opened by the Bell Telephone Laboratories.

A method of making stereoscopic motion pictures that seem to possess depth from any position and not requiring any special viewing apparatus between the subject and the screen was described by Dr. Herbert E. Ives, of the Bell Telephone Laboratories.

A film phonograph that records sound on film as in the talking movies, and will play for several hours on a single roll of film, was demonstrated by Dr. G. H. Hewlett, of the General Electric Company, to the Society of Motion Picture Engineers, meeting in New York.

A conference was held in Washington by the National Fire Protection Association in cooperation with the Departments of Agriculture and Commerce to study the problem of spontaneous combustion; the theory was advanced by Dr. Charles A. Browne that the mysterious phenomenon was due to both chemical and biological processes.

A compound about three hundred times as sweet as sugar was evolved from corncobs by Dr. Henry Gilman and A. P. Hewlett, organic chemists at Iowa State College.

A blow-torch of the oxy-hydrogen type, but using powdered aluminum instead of a combustible gas, was invented by Dr. Frank M. Strong, of Syracuse University.

The cause of "winter damage" to fabrics laundered in the winter was discovered by the U. S. Bureau of Standards to be the presence in the atmosphere of sulphur dioxide from winter fires, and the use of calcium bicarbonate in the final rinsing water materially reduced the loss.

Chemists at the University of Illinois showed how to make illuminating gas out of cornstalks and sewage.

In tests made at the Department of Agriculture's full-size gas-producing unit it was demonstrated that gas produced from straw may be used for lighting and heating and as a motor fuel.

Chemistry

The Nobel prize in chemistry for 1929 was awarded to Dr. Arthur Harden, of London University, and Prof. Hans von Euler, of the Stockholm High School, for their work on yeasts and sugars.

The Royal Society's highest honor in chemistry, the Davy Medal, was awarded Prof. G. N. Lewis, of the University of California, for his contributions to classical thermodynamics and the theory of chemical valence.

A paper on "Light Structural Alloys" presented several years ago won for Bradley Stoughton the Grasselli Medal for 1929.

Dr. Herbert H. Dow, for achievements in the fields of bromine, alkalies, magnesium and magnesium salts, and phenols, was awarded the Perkins Medal for 1930 by vote of a committee representing the Society of Chemical Industry, the American Chemical Society, American Electrochemical Society, American Institute of Chemical Engineers, and the Societe de Chimie Industrielle.

The medal of the Charles Frederick Chandler Foundation was awarded to Dr. Irving Langmuir, president of the American Chemical Society and assistant director of the research laboratory of the General Electric Company.

The third award of the American Chemical Society's "Priestley Medal Award" was given to Francis P. Garvan for the work he has done to further chemical research.

The International Committee of the Red Cross at Geneva offered a prize of 10,000 Swiss francs for a practicable means for detecting minute amounts of mustard gas in the air.

An isotope, or chemical twin, of the element carbon was discovered by Dr. Arthur S. King, of the Mt. Wilson Observatory, and Dr. Raymond T. Birge, of the University of California.

Two isotopes, or chemical twins, of oxygen were discovered by Prof. W. F. Giauque and H. J. Johnston, of the University of California.

Hydrogen was proved to exist in two molecular forms—orthohydrogen and parahydrogen—by a young German chemist, Dr. K. F. Bonhoeffer.

A new helium production plant near Amarillo, Tex., brought about the conservation of the largest helium-bearing natural gas field known and the assurance of ample supplies at half the former cost of this rare non-inflammable gas for the operation of military dirigibles.

The respiration ferment, described as ruling the organic world, was made artificially in the laboratory by Prof. Hans Fischer, of Munich, this being one of the most important contributions ever made in biochemistry.

A semi-commercial factory for the extraction of xylose from cottonseed hulls was built and put into operation by the U. S. Bureau of Standards in cooperation with the Alabama Polytechnique Institute, the University of Alabama and the Federal Phosphorus Company, of Anniston, Ala.

Biology

The Mediterranean fruit fly, one of the most destructive of all insect pests, was discovered in Florida in April; over $4,000,000 has already been spent in an effort to eradicate it and an appropriation bill for $15,000,000 more is now before Congress.

The past year was the worst forest fire year since 1910; the damage to national forest land was about $5,000,000, and more than twenty-two fire fighters lost their lives; but due to improved methods of fire control the area burned over in the national forests was kept down to about 937,000 acres or less than half that burned in 1919.

That evolutionary changes may be due to the action of radiations from the earth on the germ cells of organisms was suggested by Dr. E. B. Babcock and Dr. J. L. Collins, of the University of California.

Mutations, or sudden evolutionary changes, occur in organisms exposed to X-rays in proportion to the number of negatively charged electrons reaching the organisms, in experiments performed by Dr. Frank Blair Hanson, of Washington University, St. Louis.

Through a study of 111 pairs of twins, Dr. Madge Thurlow Macklin, of the University of Western Ontario Medical School, found that one of a pair might be born with defects such as Mongolian imbecility, while the other was normal, showing that such defects are probably not due to prenatal conditions.

Experiments on pigeons conducted by Dr. Oscar Riddle, of the Carnegie Institution of Washington, established the fact that abnormally sized glands can become hereditary.

Arrangements were completed for the establishment of an ape colony in Florida to permit the study of these animals under conditions as nearly natural as possible.

Charles Darwin's house at Down, England, was dedicated as a scientific shrine.

The Thirteenth International Physiological Congress met in Boston during August.

Living specimens of an almost extinct and very valuable species of rubber tree, *Euphorbia intisy,* were brought back to the United States from Madagascar. They are being grown in the greenhouses of the Department of Agriculture in Washington and in the Southwest.

A new wilt disease which causes cotton plants to lose leaves and bolls was reported by Dr. O. D. Sherbakoff, of the Tennessee Agricultural Experiment Station.

Larch canker, a serious disease threatening several valuable conifer timber species, was discovered in Massachusetts and Rhode Island; the U. S. Forest Service destroyed all discoverable traces of it before the end of the year.

A joint expedition of Yale University and the Carnegie Institution of Washington went to Belgian Africa to study the mountain gorilla.

Geranium flowers and leaves were found to be a deadly poison to the Japanese beetle by Charles H. Ballou, of the U. S. Department of Agriculture.

Truly marvellous was the progress of science in 1929—yet we are but touching the fringes of great discoveries.

This is the hinterland of science. Beyond are the vastnesses.

Could we but stand on the pinnacle of a century hence—and look backward—what progress would then be ours to contemplate!

Yet it is not to be overlooked that the achievements of a century hence will have but the totality of progress recorded in each of the unit years that contribute to the century.

Mankind will achieve to the eminences—only slowly—only painfully—each generation profiting through the experiences of those gone ahead—each passing a better-burning torch to the oncoming searchers.

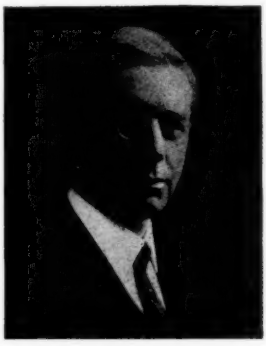
And in science, at least, 1929 has kept its tryst with progress.

ORIGINAL ARTICLES

HEART BEAT AND BLOOD FLOW*

By Horatio C. Wood, Jr., M. D.

THAT UNFORTUNATE and foolish monarch, Charles I, who lost his head so completely and literally, did one thing for which humanity should ever be grateful. He made John Harvey his private physician. This royal favor emboldened Harvey to publish his revolutionary theory of the circulation of the blood, and at the same time gave him the prestige to force his skeptical contemporaries to listen to him. Harvey's discovery may well be said to be the birth of modern medicine; from it springs not only our present understanding of diseases of the circulatory apparatus, but, also, on it has been built a large part of our knowledge of physiology. In the 300 years since Harvey's theorem we have added to it certain refinements, but the fundamental principle which he propounded has undergone practically no alteration.



Horatio C. Wood, Jr., M. D.

The word "circulation" is derived from the Latin "circulo"—to form a circle—and the basic and novel idea for which Harvey is responsible is that the heart and blood vessels form a complete circle, or rather a double circle, through which the blood runs continuously in one direction. Before his time the flow of blood had been conceived as a to-and-fro motion, like the ebb and flow of the tides. The two circles are so intertwined that neither of them is complete without the other. The smaller circle is through the lungs and is connected with the larger circle which goes through the rest of the body.

The pump which drives the blood around these circles is called the heart. It is divided into two parts: a smaller one, lying towards the right side of the body, which pumps the blood through the lungs, and a larger one, lying to the left, which forces the blood through the rest of the body. The blood which is pumped by the right side of the

*One of a Series of Popular Science Lectures given at the Philadelphia College of Pharmacy and Science, 1929 Season.

heart passes through the lungs and empties into the left heart, and by this is pumped through the rest of the body, eventually reaching the right side to again start on its course around the body. Each side of the heart is divided into two cavities: a vestibule for the reception of the blood flowing into the heart, known as the auricle, and the real pump, which is called the ventricle.

The heart is a hollow muscular organ, when contracted about the size of the fist, lying in the upper part of the chest, nearly in the middle. The pulsation that can be felt in the neighborhood of the left nipple represents the extreme left-hand border of the heart. Around

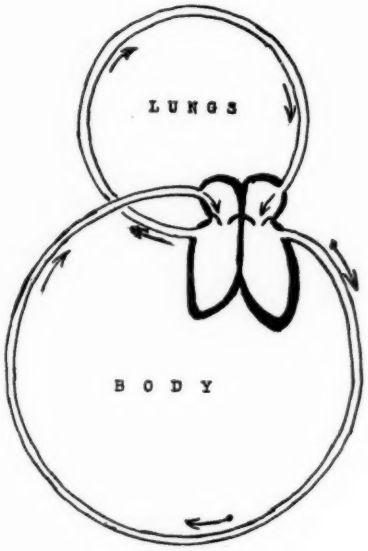
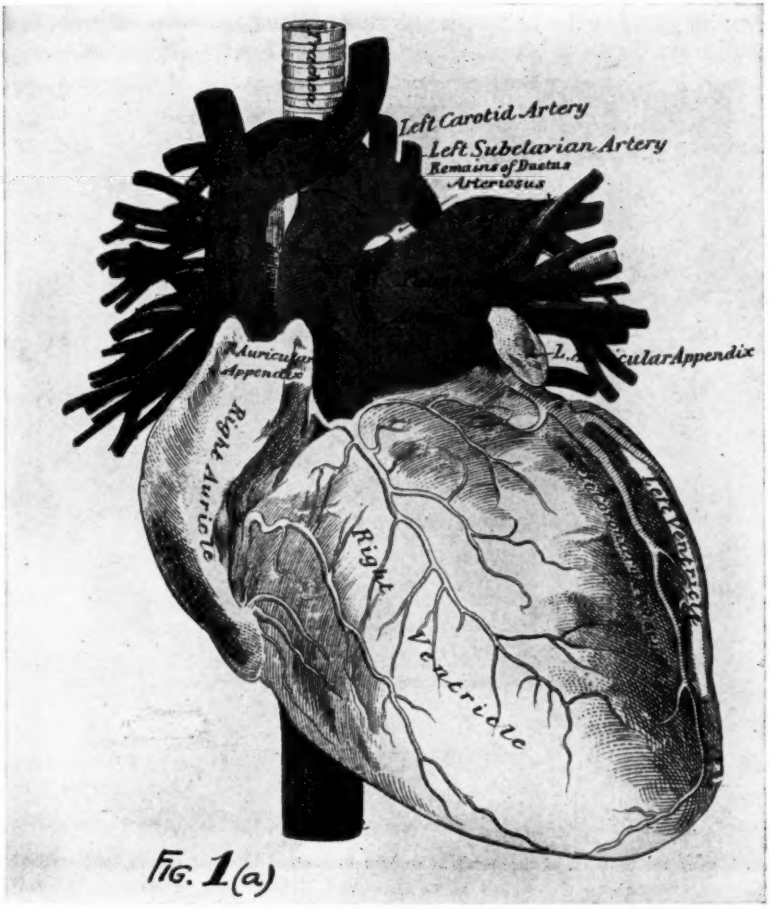


fig. 1

Diagrammatic scheme of the two circles of blood flow through the lungs and the rest of the body, with the heart in the center forming the connection between them.

the heart is a membrane, called the pericardium, which forms a sort of sac. This membrane tends to lessen the rubbing or friction of the heart against the lungs, which almost entirely surround it. The amount of work that this little mass of muscle performs is simply stupendous. Every minute each ventricle pumps about seven quarts of blood. In an hour, therefore, the heart would pump nearly twenty-seven barrels of blood, while the quantity pumped in one week would fill a cylindrical tank 10 feet in diameter and 22 feet high. This enormous amount of work is accomplished by a mass of flesh weighing less than twelve ounces.

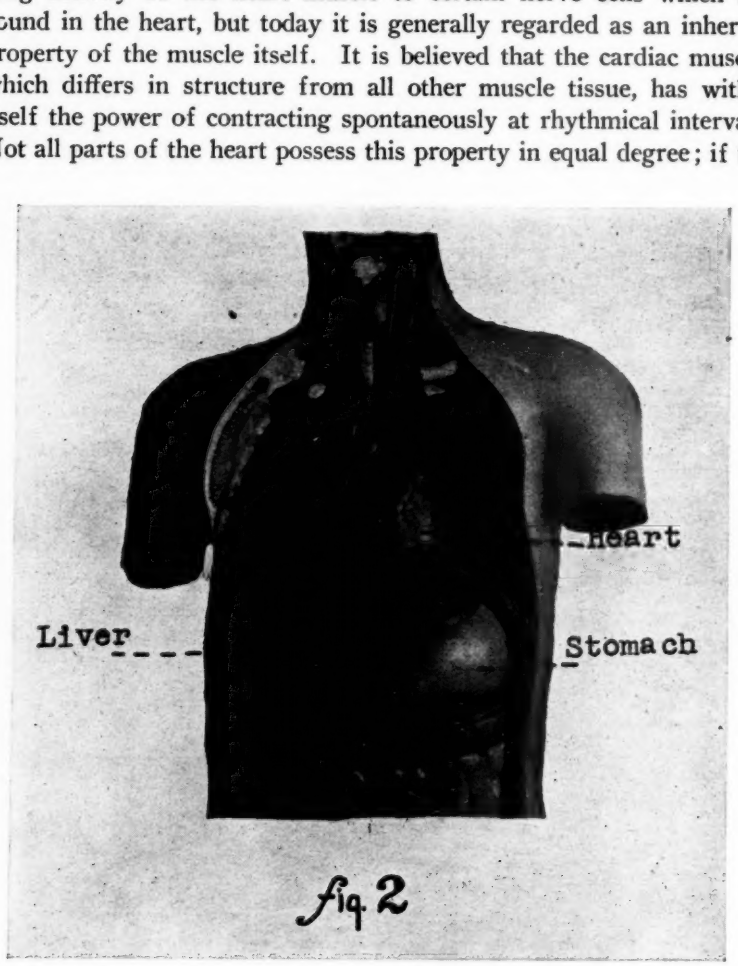
What makes the heart beat? Other muscles of the body contract only when an exciting stimulus affects them, and then they respond to each stimulation with a single contraction. But the heart muscle goes on contracting continuously at regular intervals without any apparent cause. Remove the heart of a frog from the body entirely, lay it on a



Showing heart and great vessels. (After Allen.)

plate, and it will continue to beat for hours. The heart of a warm-blooded animal will also beat under similar conditions although not for so long a time. By furnishing it with proper blood, however, even the heart of a man has been kept beating for twenty-four hours entirely outside of the body.

At one time physiologists were inclined to attribute this continuing activity of the heart muscle to certain nerve cells which are found in the heart, but today it is generally regarded as an inherent property of the muscle itself. It is believed that the cardiac muscle, which differs in structure from all other muscle tissue, has within itself the power of contracting spontaneously at rhythmical intervals. Not all parts of the heart possess this property in equal degree; if the



Showing the location of the heart in reference to other internal organs. (After His.)

ventricles be separated from the rest of the heart they may continue rhythmically contracting but at a much slower rate than normal. The most actively beating portion is just at the junction of the great veins with the auricle. The contraction wave which starts here spreads through the rest of the heart, making the ventricles beat more rapidly than they would by themselves. This area is therefore often called the "pacemaker" of the heart.

The real work of the heart, as I have said, is performed by the ventricles, and the opening into each ventricle is guarded by valves so arranged that the blood can only flow in one direction. These valves are formed of folds of the lining membrane of the heart, which is called the endocardium. In certain infections of this lining membrane, which we call endocarditis, the valves may become distorted so that they cannot function properly. The result of this is similar to that produced by a leaky valve in an automobile, namely, a reduction in the efficiency of the engine. This can be, to a certain extent, compensated for by greater activity of the muscle of the heart. If there is not too great a strain thrown upon such a heart, even despite the dis-

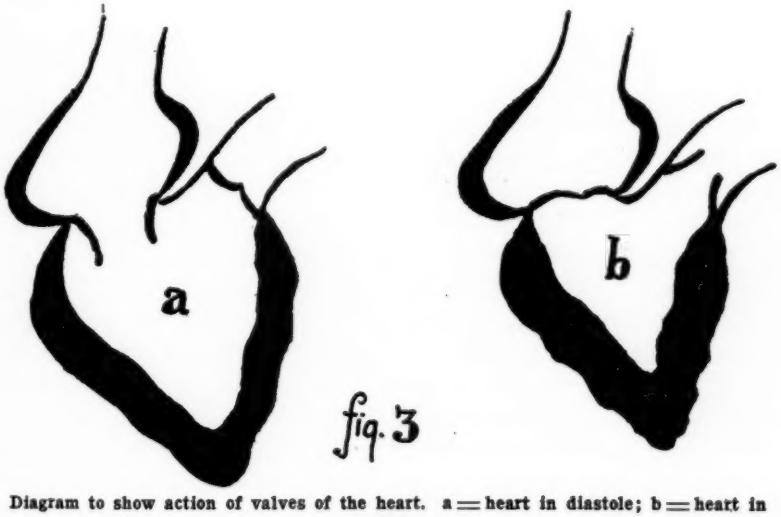


Diagram to show action of valves of the heart. a = heart in diastole; b = heart in systole.

advantage of a leaky valve, it may continue to fulfill satisfactorily its functions for an indefinite period of time. It is important, however, to remember that even although apparently doing its work adequately, it is nevertheless distinctly reduced in its mechanical efficiency and is likely to be overtaxed by sudden increases in demand made upon it, as by violent exercise. For this reason persons who suffer with valvular heart diseases, while they need not worry about shortening their span of life, should always be careful about over-exerting themselves.

The pipes or tubes through which the heart pumps the blood are of three kinds: the arteries through which the blood leaves the heart, the veins which carry the blood back to the heart, and the capillaries,

which are very minute blood vessels between the arteries and the veins. These capillaries, although extremely small—averaging about one-two thousandth of an inch in diameter—form a complex network all over the body, which will hold more fluid than all the large arteries and veins combined.

It takes force to drive a fluid through such a series of tubes, and when the driving force meets the resistance which is caused by the friction against the walls of the vessels in which it is enclosed, there develops what is known as pressure. If the fluid in such an arrangement of tubes is water, we would call it hydraulic pressure, but when it is blood we call it blood pressure. Ordinarily when we speak of blood pressure we mean the pressure in the arteries; in the capillaries there is relatively little pressure and in the veins scarcely any at all. The degree of pressure may be expressed in various ways. Sometimes we express it in terms of force exerted against a given area of surface; we say, for example, that the atmospheric pressure is fifteen pounds to the square inch. More commonly and more conveniently we measure pressure in terms of the height of a column of fluid which it will maintain. The height of this column will depend not only on the degree of pressure but also on the weight of the liquid. For the higher degrees of pressure, as represented in the circulation, it is convenient to use mercury, the heaviest known liquid. The principle is that of a mercury barometer. The atmospheric pressure of fifteen pounds to the square inch will hold up a column of mercury thirty inches high, or, if we express it in the metric system, 760 millimeters. The pressure in the arteries varies considerably, not only with the health and occupation of the individual, but changes from second to second with every beat of the heart. Normally it fluctuates from beat to beat between 70 and 120 millimeters of mercury.

The period of contraction of the cardiac muscle which forces the blood onward we call systole, and the period of relaxation of the heart, during which it is being filled with blood, we call diastole. Naturally the pressure in the arteries will be highest immediately after the contraction of the heart; this we call the systolic pressure. The lowest pressure, which occurs during the period of relaxation, we call the diastolic pressure. In a healthy young adult the systolic pressure will usually range between 110 and 130 millimeters of mercury, while the diastolic pressure will be between 65 and 80. When the physician talks to his patient about the height of the blood pressure he usually gives the figures for the systolic pressure. It is the difference between

the systolic and diastolic pressures which causes the throbbing that can be felt in various parts of the body, notably the wrist, the side of the neck and in the temples, which we call the pulse. This difference in the degree of pressure is called the pulse pressure.

One of the most interesting facts about the blood pressure is that although the heart is completely at rest, not pumping at all, for periods of half a second or more, there always remains in the arteries a certain degree of pressure. This is due to the fact that the arteries are not rigid but are elastic, contractile, tubes. When they are over-filled by the systole of the heart they stretch to accommodate themselves to the larger volume of blood, and then during the period of diastole gradually contract, forcing the blood onward into the capillaries. We have an analogous situation in the case of a fire engine. Here is a rhythmically acting pump, but the stream which issues from the nozzle of the hose is a steady, not an intermittent one. This is accomplished by having the engine pump the water into an enclosed space against a cushion of air which maintains the pressure in the hose between the strokes of the pump.

If we remember that the basis of the pressure in the arteries is the friction of the fluid passing through the arteries, it is obvious that the degree of pressure will depend not only upon the pumping force of the heart but also upon the resistance which the arteries offer and upon the fluidity of the blood itself. Very evidently it would require more force to pump molasses than it would to pump alcohol.

The amount of force exerted by the heart may be altered by changing either the number of contractions per minute or the size of each contraction. Some of the older members of my audience may have had the pleasure in their boyhood days of working on a farm before the advent of the electrical pump. You know that on a frosty morning, when you were in a hurry to fill the water trough for the horses, you could do so more quickly either by making rapid strokes or by swinging the pump handle through its largest possible arc. So the heart can increase the amount of blood it pumps either by beating at a more rapid rate or by contracting to the fullest possible degree at each beat.

The resistance offered by the arteries varies with the smoothness of their interior lining, also with their caliber (that is, their internal diameter), and also, to some extent, with the ease with which they stretch. Take the nozzle off the end of a hose and the pressure immediately diminishes, as can be gauged by the force of the stream. The

reason that the pressure diminishes in the hose is because the relatively large caliber of the hose offers little resistance to the passage of the water. If the arteries dilate suddenly, the blood pressure may fall to a dangerously low level. That is the reason that the so-called "solar plexus blow" in the abdomen will sometimes knock a person unconscious; the solar plexus contains the nerves which regulate the caliber of the arteries in a very large part of the body, and injury to these nerves causes a sudden dilatation of these vessels. Indeed, a man will die more quickly from injuries to the nervous system regulating his blood vessels than he will from being stabbed in the heart.

High blood pressure is at present a very prevalent condition. It is not, properly speaking, a disease, but it is a symptom which may occur in a large variety of diseases. It is well known that the blood pressure of persons in advanced years is usually higher than in the days of their youth, even in healthy persons. This rise, which may be called the natural rise in blood pressure, is due to the fact that our arteries, like our other organs, become less elastic as we grow older. Sometimes the interior lining of the arteries becomes roughened and thereby makes more friction, which in turn causes an elevation of blood pressure. At other times increased blood pressure may be due to constriction of the arteries caused by purely nervous factors; a sharp temporary rise in blood pressure will occur in almost any one upon being suddenly startled. Certain poisons, which may arise within the body or which may be introduced from without, can excite the blood vessels to undue contraction and thereby cause high pressure.

In some persons a blood pressure higher than that of the average seems to be natural and people are not infrequently made uncomfortable by injudicious lowering of the blood pressure below that which is normal for them.

The chief danger which comes from high blood pressure is due to the increased strain which is thrown upon the heart trying to drive the blood forward against unusual resistance. The dangers of bursting a blood vessel, which alarms so many people, is rather a remote one. Blood vessels rarely burst if they are healthy, except as the result of direct violence. I have seen persons with systolic pressures more than twice as high as that which we consider normal apparently unconscious that anything was the matter with them.

Apoplexy, or, as it is commonly called, a stroke, is due to the bursting of a blood vessel in the brain, which will be followed by cerebral hemorrhage, and leads to paralysis of greater or lesser extent,

according to the size of the artery which has broken. The blood vessel bursts because of some disease which has weakened its walls. If the blood pressure remains so low that no strain is thrown upon this weakened artery, the patient may go along for years unconscious of any trouble, but some excitement causing a sudden rise in the blood pressure may lead to the rupture of the diseased vessel.

Diseases of the heart are increasing at an alarming rate. In the State of Pennsylvania in the past twenty years the general death rate has fallen from 16 per thousand to less than 12 per thousand, but the death rate from heart disease has gone up 60 per cent. In the statis-

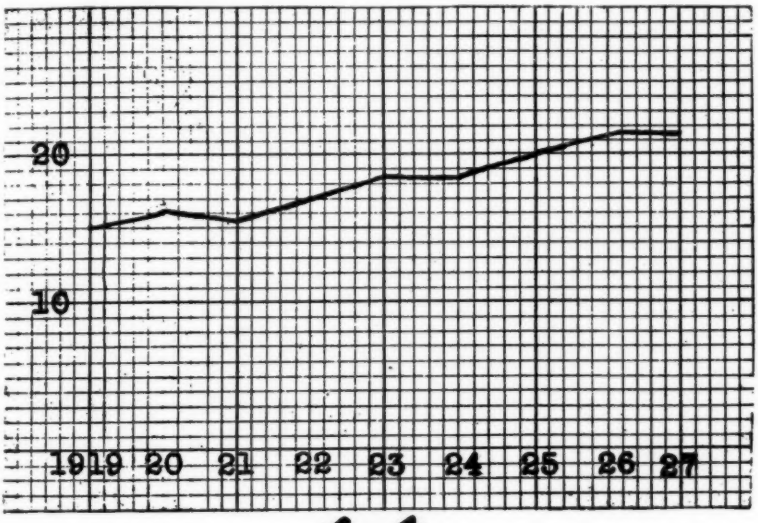


Fig. 4

The rise in death rate from heart disease in Pennsylvania. Figures to the left represent deaths per 10,000 of population; figures below the year.

tics of the Department of Public Health, heart disease has risen from fourth to first place in the causes of death. There is a similar and scarcely less striking increase in the number of deaths of diseases of the arteries.

Diseases of the heart may be divided into two groups: those in which the membranes are primarily affected and those which chiefly affect the muscle. Of the membranes, the interior lining is the more frequently attacked. Inflammations of this membrane are called endocarditis. They may follow a large number of infections in various parts of the body. Among the most frequent causes of endo-

carditis may be mentioned rheumatic fever, tonsilitis, gonorrhea, scarlet fever, septicemia (blood poisoning), etc. As the endocardium covers also the valves of the heart, these inflammations often lead to deformities and leaky valves, which remain as a permanent disability. The disadvantages of leaky valves I have already referred to. Sometimes the muscle after awhile grows enough stronger to carry the extra burden imposed on it, because of the leaky valve, without serious inconvenience. When this happens, the doctors say the heart is "compensated." A person with a compensated valvular lesion may continue to live an almost normal life for an indefinite number of years, but he should always remember that his heart is working at a disadvantage and avoid subjecting it to unnecessary strains, as by violent physical exertion or excessive smoking.

Diseases of the muscle are of such a wide variety of types and of so different degrees of danger that it is almost impossible to give any brief outline. Young persons may recover from them with no apparent remaining ill effect. But in the later years of life as a rule they are a more serious menace than the valvular defects. Muscular lesions of the heart may be caused by any of the infections which give rise to endocarditis, but in addition they may be brought about by various poisons (such as tobacco, headache tablets, alcohol, etc.) or by simply overstraining the heart as in too violent athletics. Frequently they are the result of those changes which, in a minor degree, are occurring in all of us as the years go by, called, popularly, hardening of the arteries.

The amount of disability which results from disease of the heart muscle may range from a scarcely perceptible reduction of normal activity to complete incapacitation.

There is one type of cardiac lesion to which I would like to call especial attention because it is so common a complication of many diseases of the heart and is so frequently the indication of the beginning of the end. This is the condition known to the medical profession as dilatation, which is a stretching of the heart muscle. Whenever the labor that the heart has to perform is beyond its capabilities, becoming unable to empty itself of the blood which continues to flow into it, the muscle begins to stretch to accommodate the abnormal amount of blood which it is unable to evacuate. As the cavity of the heart grows larger, it is obvious that the walls—that is, the muscular tissue—must become thinner, just as when you blow up a toy balloon, the bigger you blow it up the thinner are its walls. As the muscles

become thinner they lose, to a considerable degree their efficiency; they are less able to perform their function. Unless the heart is relieved of its too heavy load it must, therefore, continue to stretch and stretch, its contractions becoming less and less efficient, until finally they cease altogether.

Mild degrees of dilatation are very frequently found in the performers after a severe athletic contest. When the strain is removed, if the athlete be youthful and healthy, the heart rapidly regains its normal tone and within twenty-four hours may be as efficient as ever.

One of the earliest and most certain signs of advancing years is loss of elasticity in our tissues. Elasticity is not the power to stretch, but it is the power to return to the normal condition after having been

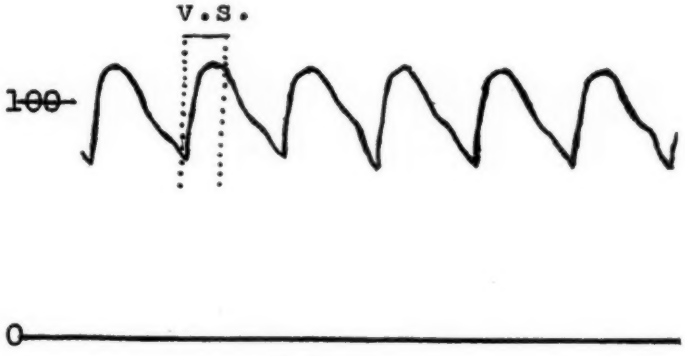


Fig. 5

Showing pulse pressure. V = ventricular diastole; S = ventricular systole.

stretched. Take a rubber band and pull it out and leave go; the band flies back because it is elastic. You stretch out a piece of taffy candy and leave go, and it does not go back because it is inelastic. Take a piece of rubber that has been kept in your desk until it begins to change, and you will find that while it has some elasticity left, when you stretch it it returns much more slowly to its proper size, and if stretched too much will not return at all. So it is with our tissues, especially the heart.

A study of the statistics of the deaths from heart disease shows that the great increase has been in persons above forty years of age. In youth the heart, even when diseased, temporarily overburdened, will recuperate rapidly if relieved of its strain, but in later life a heart once overtaxed returns but slowly, if at all, to its former strength.

As our hair turns gray we must learn, if we wish to live useful lives, that we cannot overstrain, even for a short time, our hearts with impunity.

Every time our muscles contract they require more blood. More blood to the muscles means more work for the heart. Lie quietly in bed and count your pulse and then get up and walk across the room and count your pulse, and you will find that even such a very moderate degree of exercise as walking across the room will reflect itself in increased work of the heart. Climb up a flight of stairs and the

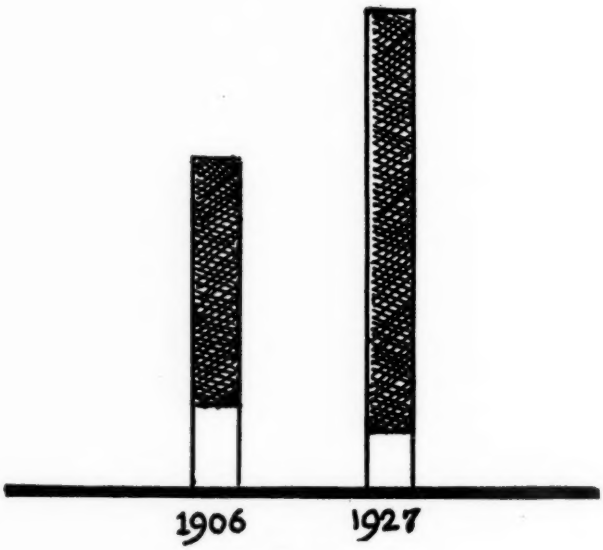


Fig. 6.

Comparative mortality from heart disease in 1906 and 1927. The light area represents deaths under 40 years of age, the dark area over 40.

increase in the pulse rate is very much greater. Run up a flight of stairs and you will be panting for breath and your heart hammering. Generally speaking, the more quickly we move, the greater is the muscular energy expended, and consequently the greater demand upon the heart. The price lesson that patients with heart disease must learn is not to hurry, and I might remind those of you who have reached middle life that every one of you is a potential case of heart disease. Just how much the heart will stand, just how much it is safe for us to hurry or exert ourselves, varies with each individual. But there is

a limit for every one of us, and the prudent man will realize his limitations.

Another source of strain upon the heart is undue constriction of the arteries. I have already pointed out how the contraction of the arteries, by increasing resistance to the flow of blood, tends to elevate the blood pressure. The greater resistance of contracted arteries must be overcome by increased work of the heart. High blood pressure, therefore, means more strain upon this organ. Persons with weak hearts must therefore avoid, as far as possible, raising their blood pressure.

One of the most frequent causes of acute high blood pressure is nervous excitement. Every time we become angry or frightened, rise in blood pressure is well marked, and even pleasurable forms of excitement, such as the thrill which some get from beautiful music, means more work for the heart. The old saying that "good news never killed anyone" is not true; many persons with weak hearts have died of the excitement of pleasure.

Fortunately nature here has arranged a compensatory mechanism for those of advancing years, because as we grow older and our hearts become less elastic, we become less easily excitable. If we miss the pleasant thrills of our youth, we miss also the devastating vehemence of passion. The old man who resurrects youthful emotion is as foolish as he who tries youthful athletic feats.

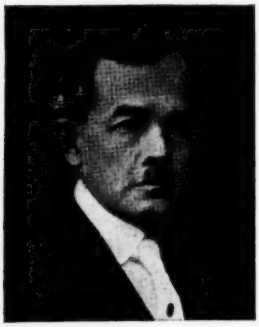
Lest some should misunderstand me to recommend a life of sloth as the gateway to longevity, let me add that disuse of our functions is as deadly to their efficiency as overuse. If we take no exercise our muscles atrophy, grow weaker. The heart is no exception. It needs the stimulating effect of overcoming obstacles. It often tasks to the utmost the skill of the most experienced physician to determine in any individual case just exactly where lies the border between healthful, beneficial, exercise or excitement and deleterious overexertion. I am not advocating idleness any more than I am recommending violence. Richard Steele, the famous essayist, said, "He that is moderate in his wishes from reason and choice, doubles all the pleasures of his life." I might paraphrase and say that he who is moderate in his exercise and pleasure doubles the days of his life.

THE CARBON OXIDE BROTHERS, MON AND DI*

By Freeman P. Stroup, Ph. M.

Professor of General Chemistry, Philadelphia College of Pharmacy and Science

DOUBTLESS some of our auditors this evening have considered the subject of this talk rather far-fetched. To speak of forms of non-living matter as brothers may seem without good reason, but the fact that you are here shows that your interest has been excited, and that is "the why" of our title. It may not be so far-fetched after all when one considers that these two substances are of the same "parentage," so to speak, or compounds of the same elements—carbon and oxygen; are similarly named—carbon *mon*oxide and carbon *di*oxide; are both colorless gases; are as unlike in many particulars as any two brothers you ever knew; are more often found together than separated.



Freeman P. Stroup, Ph. M.

WHY "MON" AND "DI"?

These prefixes are appropriated from the Greek, and mean, respectively, *one* and *two*. The chemist uses abbreviated expressions in place of names for most of the compounds about which he writes, and these he calls "symbolic formulas," "chemical formulas," or, more generally, "formulas." For carbon *mon*oxide he writes CO, and for carbon *di*oxide he writes CO_2; in which C represents one "combining weight," so-called (or 12 parts of carbon), O represents one "combining weight" (16 parts of oxygen), and O_2 represents two "combining weights" (32 parts of oxygen). In carbon *di*oxide there is always twice as much oxygen by weight as there is in carbon *mon*oxide, hence the reason for the differences in nomenclature.

OTHER NAMES

Carbon monoxide is sometimes called "carbonic oxide," and carbon dioxide is sometimes called "carbonic acid," particularly by chemists and others in the autumn period of life. The solution of CO_2 in water (CO is practically insoluble in

*One of a Series of Popular Science Lectures given at the Philadelphia College of Pharmacy and Science, 1929 Season.

water) is acid in reaction and taste, and this acid is the basis of a class of salts known as carbonates; hence the name "carbonic acid" properly belongs to the acidic constituent of such a solution (the chemist writes it H_2CO_3) and the name "carbonic oxide" should then be given to CO_2, the *oxide* which produces the *acid*. "Carbonic acid gas" is another name sometimes used, for obvious reasons. The chemist expresses the reaction which takes place when the gas dissolves in water by what he calls an "equation":

$$CO_2 + H_2O \longrightarrow H_2CO_3$$
(Carbon Dioxide) (Water) (Carbonic Acid)

At the "soda counter" of the drug store, the candy shop, or the "five-and-ten," this solution is known as "plain soda."

It will be seen that both oxides are known to different people as "carbon oxide," a source of much confusion; hence the reason for modern chemists using the terms "mon" and "di."

"Deadly monoxide gas" and "monoxide" are terms used by newspapers as synonyms for carbon monoxide, particularly in headlines of news articles concerning poisoning by this substance. At this time of the year (winter) these terms catch our eyes more often than in summer, for reasons that will appear later on in this discussion.

NATURAL OCCURRENCES

So far as the speaker knows, there is no occurrence of carbon monoxide in nature, but there are numerous natural sources of the dioxide. A few may be mentioned.

a. Every breathing animal, including the human animal, discharges into the atmosphere with every expiration from the lungs some carbon dioxide. This can be easily demonstrated. If we breathe for a few moments into a glass vessel the inside of which has been moistened with lime water we note a cloudy film on the surface of the glass; or if we bubble the breath for a few moments through lime water we note the separation of a white insoluble substance. Lime water is a saturated solution of calcium hydroxide, and the film on the glass in the first demonstration and the precipitate in the second is calcium carbonate. The following equation expresses what has taken place:

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$$
(Calcium Hydroxide) (Carbon Dioxide) (Calcium Carbonate) (Water)

b. Whenever certain sugary substances undergo a certain type of fermentation there is formed, among other things, carbon dioxide; so

when your fruits and fruit juices "work" (as some people always designate this type of fermentation) the frothing on the surface, and the development of pressure within the container (if it be a closed one), is due to the carbon dioxide formed. Likewise, when bread and other food products are made with the use of yeast the so-called "raising" or "rising" is caused by the formation of carbon dioxide throughout the mass of the mixture or dough. In the "curing" of ensilage in the farmer's silo this gas is formed, and some fatalities have have resulted from persons (either not knowing or overlooking this fact) entering such a silo without first giving it a thorough ventilation. Decaying vegetation in the presence of water, as in the bottoms of old wells, sometimes forms this gas; hence it is unsafe for a person to descend into wells or pits without first having tested the air of the well or pit. This can be easily done by lowering a lighted lantern—if the flame is not extinguished the amount of carbon dioxide present is insufficient to make the air unsafe to breathe.

c. Whenever any form of carbon, such as coal, coke or charcoal (yes, and diamonds or graphite), is burned in oxygen or with its aid, carbon dioxide is formed. Air contains about 20 per cent. oxygen, and this is quite sufficient to permit the combustion of coal, coke and charcoal, but not of diamonds or graphite. If combustion is incomplete, carbon monoxide is generally formed. The commonest cause of incomplete combustion is an insufficient supply of air (hence, of oxygen), and coal, coke and charcoal fires have to be carefully regulated to prevent the presence of carbon monoxide in the final products of combustion. When carbon burns to carbon monoxide only about one-third the heating value is obtained, the other two-thirds being realized when monoxide burns to dioxide, and this is the very best reason for aiming to regulate fires in such a manner as to have only the dioxide going up the chimney.

d. Whenever any compound of carbon burns in air or oxygen, carbon dioxide is among the gases formed if the combustion is complete. Sometimes carbon monoxide is formed, especially if the oxygen supply is low, but very often the carbon not burned to carbon dioxide is separated in the free state and known commonly as soot. Among the most familiar substances used for fuel, or for lighting purposes in many instances, which are compounds of carbon, or mixtures of such compounds, are wood, gasoline, kerosene, fuel oil, natural gas, artificial gas, fats, waxes, wood alcohol, grain alcohol, etc. Here again the aim should always be to so conduct the combustion that carbon

dioxide will be the only carbon compound among the final products of combustion.

A few simple tests will suffice to demonstrate the formation of carbon dioxide in the combustion of carbon compounds of various kinds. We will moisten the inside of each of a number of goblets with lime water and hold one each for a few moments over the flame of (a) a match, (b) an oil lamp, (c) an alcohol lamp, (d) a gas jet, (e) a candle. In each case we note the development of a turbidity in the drops or film of liquid adhering to the inside of the goblet, the turbidity being due to calcium carbonate formed by the action of carbon dioxide on the calcium hydroxide of the lime water, as explained earlier in this discussion.

e. Most carbonates, when strongly heated, decompose, the products of decomposition being carbon dioxide (which comes off as a gas) and a metallic oxide (which remains in the vessel in which the carbonate has been heated). A very common example of such a process is the so-called "burning" of limestone, chalk, oyster shells, marble, and other forms of calcium carbonate to produce "lime," "burnt lime," "quicklime," or "stone lime," which are names given by farmers, builders, whitewashers and others for what the chemist knows as calcium oxide. The latter pictures the reaction that takes place with the equation:

$$CaCO_3 + \triangle \longrightarrow CaO + CO_2$$

(Calcium Carbonate) (Heat) (Calcium Oxide) (Carbon Dioxide)

In the occasional production of lime, as on a farm in a limestone section of country, the carbon dioxide is allowed to escape into the atmosphere; in industrial plants where the production of lime is a regular process the carbon dioxide is generally collected, to be used about the plant or to be sold to some other concern.

The production of a fine grade of litharge (lead oxide, PbO) from lead carbonate ("white lead"), the making of "zinc white" (zinc oxide, ZnO) from zinc carbonate, the manufacture of "magnesia" (magnesium oxide, MgO) from precipitated as well as native magnesium carbonate, are other utilizations of the effects of heat on carbonates. There are many others.

f. When ammonium carbonate (so-called "baking ammonia") is heated it gives off two gases, ammonia (NH_3) and carbon dioxide (CO_2), as some of the ladies present may know from their experience in baking certain kinds of cookies. At least they know of the production of the ammonia—if their respective noses are functioning as they should.

g. Whenever bicarbonates are heated, even moderately, they decompose, evolving carbon dioxide and leaving a residue of a carbonate. The speaker has known of instances where the housewife put sodium bicarbonate (she knew it as "baking soda") into a cake or biscuit batter and forgot to add sour milk, cream of tartar, or other acidic substance. Results are anything but gratifying. The mass lightens somewhat in the baking process, the heat effecting the liberation of half of the possible carbon dioxide and expanding it, but, oh, the taste of the finished product, because of the sodium carbonate (same thing as "washing soda") in it.

h. Whenever an acid or acidic substance comes into intimate contact with a carbonate or a bicarbonate, as in the presence of water, a chemical reaction ensues in the which there is formed a salt of the acid, and carbon dioxide is given off. Often the prime object of such a process is to get the salt, and the carbon dioxide is allowed to escape as being of no importance. In other instances the carbon dioxide is the substance wanted and the salt is of little or no importance. We shall cite a few illustrations:

1. The pharmacist usually makes his solution of citrate of magnesia from magnesium carbonate and a solution of citric acid, allowing the carbon dioxide to pass off; the solution is all he wants. But he uses more of the acid than is needed to decompose the magnesium carbonate, and, just before he delivers a bottle of the solution to a customer, he puts into it some sodium bicarbonate or potassium bicarbonate, which reacts with some of the excess of citric acid to produce a citrate (not the chief substance wanted) and carbon dioxide. The latter, being a gas, develops pressure in the tightly closed bottle, and when the customer opens the bottle he has an effervescent, more or less agreeable, mixture to drink.

2. Consider now the seidlitz powder, often used "the morning after" to help clear away the effects of "the night before." The blue paper contains an intimate mixture of Rochelle salt (the medicament) and sodium bicarbonate, while the white paper contains tartaric acid. When the contents of the papers are dissolved in separate portions of water and the two solutions are then mixed, there results a "fizzy" mixture which is not hard to take. The "fiz" is due to the carbon dioxide (the chief substance desired).

3. Bromo seltzer is an example of a class of preparations in which we have usually a mixture of one or more medicaments, a carbonate (usually sodium bicarbonate), and an acidic substance (tartaric acid

or acid potassium tartrate generally). So long as one of these preparations is kept dry there is no reaction (incidentally, no deterioration), but when mixed with water the carbonate and acidic substance react with each other to form the carbon dioxide needed to give the desired efferversence.

4. Baking powders are similar to the preparations just considered, except that they contain no substance intended for medicinal use, or intended to produce one of medicinal value. However, every product in the making of which a baking powder is used has in it something that often is used as a medicine, but the amount is so small that one need not refrain from eating a large piece of cake because of any possibility of getting a pronounced physiological action. Baking powders are intimate mixtures of dry powders, of which sodium bicarbonate is almost always one (this to furnish carbon dioxide), and some substance (usually acidic), usually diluted with starch. Here are some of the combinations:

a. Sodium bicarbonate and cream of tartar (potassium bitartrate)—sometimes tartaric acid.
b. Sodium bicarbonate and monocalcium phosphate.
c. Sodium bicarbonate and one or another of the several alums.

All of these are inactive when kept dry, but when allowed to become even slightly damp gradually deteriorate. When mixed with milk, water or watery mixtures, the constituents react with each other to form a compound which remains in the finished product, and carbon dioxide, which lightens the mass while still cool, expands greatly in the baking to lighten the mass still further, and dissipates into the atmosphere during the baking, or thereafter. When a cake "falls" it is because the gas has escaped before the baking has proceeded far enough to toughen the mass of dough sufficiently to enable it to stand alone—that is, without the support of the gas enclosed within its pores. This is apt to take place when the batter is thin. Opening the oven door may cause a cake to "fall," because the inrush of cooler air from the outside causes the gas in the cake mass to contract.

Reference has been made to the production of substances having medicinal action in the decomposition of baking powders. Tartrate baking powders (Type a) produce Rochelle salt; phosphate baking powders (Type b) produce sodium phosphate; alum baking powders produce sodium sulphate (generally known as Glauber's salt). All of these are cathartic when taken in considerable quantities. However

much little Johnnie would enjoy taking his physic in the guise of cake, it takes too much to bring about the desired results. Johnnie would not object, however.

i. When nitroglycerin, dynamite (nitroglycerin absorbed in a solid), guncotton (nitrocellulose), T. N. T. (trinitrotoluene), picric acid (trinitrophenol) and other so-called "high explosives" explode, both carbon dioxide and nitrogen—sometimes oxides of nitrogen—are produced. This must be taken into consideration by workers who have to clear away the debris, particularly when the explosion has taken place in a pit, mine or other enclosed depression. They should be sure that these gases have been dissipated before entering such places.

j. When "fire damp," which is a mixture of methane (CH_4) and air, in coal mines explodes, the composition of the so-called "after damp" varies according to the proportions of methane and air existing in the explosive mixture:

1. A mixture of one volume of methane and ten volumes of air produces carbon dioxide and nitrogen when exploded. Both are asphyxiants and all miners not killed by the shock of the explosion are promptly asphyxiated.

2. With a mixture of less than ten volumes of air to one of methane the gases produced are nitrogen, carbon dioxide, carbon monoxide. The first two are asphyxiants, the last one acts both as an asphyxiant and a blood poison. Miners have no chance of escaping death.

3. With a mixture of more than ten volumes of air to one of methane the gases produced are carbon dioxide and nitrogen, but admixed with them is some oxygen, the life-supporting element of the atmosphere. The chances of the miner escaping death by suffocation are good or poor, depending upon how many more than ten volumes of air to one of methane were present in the explosive mixture.

k. When carbon monoxide burns in air, carbon monoxide is produced. We shall try to show you this with some carbon monoxide which we produced this afternoon by the action of concentrated sulphuric acid upon formic acid. The equation which illustrates the reaction is

$$\underset{\text{(Formic Acid)}}{HCOOH} \longrightarrow \underset{\text{(Carbon Monoxide)}}{CO} + \underset{\text{(Water)}}{H_2O}$$

The function of the sulphuric acid is that of a water-remover (the chemist calls it a "dehydrating agent"). Some of the gas has

been collected and preserved over water, being practically insoluble in water. You will notice that it is colorless, and it is also free from odor. It should not be inhaled because it is very poisonous, attacking particularly the hæmoglobin of the blood and taking away from it its power to "carry" oxygen. Half of one per cent. in air is fatal to man and animals if inhaled for some minutes. Greater concentrations act more quickly. Its lack of odor makes it all the more dangerous. If it had odor people could detect its presence quickly and take necessary precautions to avoid being overcome by it. More will be said about its dangers later on in this talk.

Now we shall burn some of it. You notice the blue color and lambent or dancing character of the flame. Doubtless you have seen the same phenomena in a stove or furnace in which anthracite coal, charcoal or coke was burning. If so, you have actually seen carbon monoxide burning, perhaps, many times; for this is what generally happens with such a fire: air (to furnish the oxygen needed) enters under the grate and passes through the glowing fuel, the carbon of the fuel combining with oxygen to form carbon monoxide, which, along with the nitrogen from the air, escapes from the upper part of the mass of fuel. The equation which interprets what has taken place thus far is

$$C + O \longrightarrow CO$$

(Carbon) (Oxygen) (Carbon Monoxide)

It may not be amiss here to repeat that this reaction releases only about one-third of the heating value of the fuel. If air is now supplied over the mass of fuel, either through openings in the fire door of the furnace or in some other way, the carbon monoxide ignites and burns to carbon dioxide, and this reaction releases the other two-thirds of the heating value of the fuel. It is quite apparent that you must have flame if you would realize the maximum heating value from your fuel. Except with coarse coal it is practically impossible in the ordinary furnace to get air enough through the fire-bed to effect complete combustion within the mass of fuel; so some air must be supplied over the mass. The construction of most furnaces and heating devices is such that it would be highly undesirable to have complete combustion taking place in the fire-bed, but, rather, there should be only enough air passed the fire-bed to insure the conversion of carbon into carbon monoxide, which gas should then be burned above the fire-bed or beyond it in such a way that the flame should come into immediate contact with the part of the heater which is responsible for the so-

called "heat transfer" (the "tubes," etc., of steam and hot-water systems, the "drums," pipes, etc., of hot-air systems). For best results the air control should be such as will produce the longest possible flame. Short flame usually indicates too great an air supply over the fire-bed, the immediate effect of which is to lower the temperature of the gases which are to come into contact with the surfaces of the heating unit, and that means a waste of fuel. The effect is comparable with that produced on hot dishwater when cold water is run into it. Most of you know how quickly the steam "goes down" in the radiators of a steam heating system when the fire in the furnace is checked by opening the fire door. Let us do a little calculating. Let us suppose that the temperature over the fire of a heating system is 600 degrees Fahrenheit (a low estimate); now let us open the fire door and let in one volume of excess air at 60 degrees for every four volumes of the hot gases produced by the fire. Result: Four volumes at 600 (2400) plus one volume at 60 equals five volumes (2460), or an average temperature (2460 divided by 5) of 492 degrees—a drop of 108 degrees. Now, let us suppose that the inflow of excess air was equal in volume to the volume of gases produced in the combustion, in which case our calculation will be: One volume at 600 and one volume at 60 will produce two volumes at an average temperature (660 divided by 2) of 330 degrees. It is very obvious that the heating surface in any heater will not get as hot from a stream of gas at 330 or 492 degrees as from one at 600, and that checking a fire by opening the fire door of the furnace is very poor practice. Every properly equipped heater should have in the smoke outlet a door which can be opened or closed at will. Opening the door weakens the chimney draft and hence checks the fire without wasting the heat produced by what fuel is burning. Further checking can be effected by closing, or nearly closing, all ash pit openings and other openings through which air can get to the mass of burning fuel. The smoke outlet should be equipped with a damper, which damper should be wide open always, except where there is a very strong chimney draft. Never should it be completely closed, for that forces the gaseous products of combustion out of the furnace into the surrounding atmosphere, with danger of asphyxiating every living being in the house if these gases can get to other parts of the building.* If the heating system is one in which air from a basement is heated

*Shortly after this lecture was delivered one of the most prominent pharmacists in the United States lost his life in this manner.

and sent upstairs through the hot-air ducts the danger is especially great.

It might be well at this time to state that hot-air systems of the type just mentioned cannot be expected to work satisfactorily if the basement is small and tightly closed. The fire must have air in order to continue burning, and other air must be heated and sent upstairs through the hot-air ducts, and fresh supplies of air must be provided to take the place of what is being thus used. Unless some provision is made for an inflow of air from outside of the room in which the heater is located the fire will burn poorly and no hot air will go upstairs. Open a window partly, or leave the door to the upper floors partly ajar. Cold air will flow down the basement stairs while hot air goes up the ducts. The draft in the furnace and the flow of air upwards through the heating ducts is due to the difference in relative weights of hot and cold gases, hot ones being lighter than cold ones and thus having a tendency to rise; but when they rise other colder ones rush in to take their places. You cannot draw air out of a tightly closed room indefinitely, any more than you can suck it out of a bottle by putting your mouth over the mouth of the bottle and applying suction. If you put a tube into the bottle, the tube being small enough in diameter to permit the inflow of air between the outer walls of the tube and the inner walls of the neck of the bottle, you can draw out air indefinitely, as what is drawn out is promptly replaced by new air. The same thing applies to your heating system.

Another thing which strongly influences the efficiency of any hot-air heating system is the degree to which the rooms being heated permit an outflow of air. If doors and windows are tightly closed, especially when windows are weather-stripped, hot air cannot be freely forced into such a room, as something of a back pressure is developed. It is very much like a crowded street car—once it is full you cannot crowd more into it, but if some persons are let out others can come in. Loosely fitting windows and doors have many things to their credit. Doubtless many persons are alive and quite well today who would have been in their graves long ago had all windows and doors in their dwellings always fitted closely. When they fit but loosely air can get in or out relatively easy, and change of air is effected without causing perceptible drafts. To demonstrate the truth of what has been said about the futility of trying to force air into a closed room, we can reverse the procedure of our last test. When we apply the mouth to the mouth of a bottle and try to blow more air into it we

fail, but when we put a tube into the bottle and blow through the tube we can do so indefinitely, because air already in the bottle is forced out by what is being blown in through the tube.

We shall go back to our demonstration. You saw the burning of the carbon monoxide. Now, we shall prove that carbon dioxide was formed by use of the lime water test.

You have seen that carbon monoxide burns, but how about carbon dioxide? We have some here that was made from a carbonate and an acid. We shall bring the flame of a lighted paper into it. You notice that the flame is promptly extinguished.

Carbon monoxide has about the same density as air, but carbon dioxide is heavier—about half again as heavy. We have here a vessel which is empty except for the air it contains, as may be proved by testing it with a lighted taper. You will note that the flame is not extinguished. Now we shall pour some carbon dioxide into it, just as we might pour in a liquid. Of course, there is some mixing of the carbon dioxide with air already in the container, but we think enough of the gas will go to the bottom to displace most of the air. Let us test the gases in our container with the lighted taper. The flame is promptly extinguished. A practical application of what we have just shown is the use of chemical fire extinguishers. Many types depend for their efficiency upon their ability to deliver carbon dioxide into the burning materials.

CARBON DIOXIDE—POISON!

We have seen that carbon dioxide does not support combustion. Neither does it support life. It is not poisonous like carbon monoxide, but we cannot breathe it long without losing consciousness, and if breathed too long it causes death by asphyxiation. Rather large percentages of it in air can be inhaled for long stretches of time without permanently serious results. As high a concentration as 50 per cent. has been breathed for a few minutes without untoward results, while as low a concentration as 8 per cent. breathed for a long time has produced fatal results. Generally speaking, if a person overcome by carbon dioxide can be restored to consciousness and supplied with fresh air, recovery is speedy and complete; while persons overcome with carbon monoxide and restored to consciousness may be months, or even years, in recovering completely, and not infrequently has death ensued weeks after apparent recovery of the patient.

The heaviness of carbon dioxide adds to its possibilities for doing harm to man. Were it lighter than air it would soon rise and be dis-

sipated into the surrounding air. A few of the ways by which it has caused death may be cited.

a. A limekiln beside the road is in operation and carbon dioxide is escaping from the top, the wind blowing it away as it escapes; a homeless wanderer comes along; the evening is cool; here is a warm place to sleep; he lies down beside the kiln and dozes off. The wind dies away, the carbon dioxide is no longer blown away but settles about the sleeper and displaces the air he should have; he breathes the carbon dioxide, and shortly his troubles and wanderings are at an end for all time.

b. A man buys a farm on which is located an old dug well that has not been cleaned out for a long time; in the bottom is a mass of decaying vegetable matter which he decides to clean out, descending into the well for the purpose; later on some of the neighbors fish out his body; in a few days it is laid away in the churchyard and another widow is left to fight not only her own battles but those of her children in a not too charitable world; all because he did not think or know enough to lower a lighted lantern into the well to determine whether or not the air in it would support life. Wells in limestone regions may collect carbon dioxide, as rain water percolating through the limestone converts some of it into a soluble so-called "bicarbonate of lime" which decomposes, when it gets into the open, into insoluble calcium carbonate and carbon dioxide. The heaviness of the gas causes it to stay in the lower levels of the well.

c. Two silos were standing side by side and connected by a passageway; one contained fermenting ensilage, while the other was apparently empty. Two boys were playing on the roof of the empty silo and one dropped his shoe through a hole in the roof. There was a ladder down the inside and he descended to get his shoe; he was overcome and the other boy went after him. The father being near, spread an alarm and a farmhand responded, tied a wet handkerchief over his mouth, opened a door at the bottom of the silo, rushed in and brought out both boys—now dead—then collapsed himself, but was speedily restored to consciousness.

CARBON MONOXIDE—POISON!

Mention has been made of the poisonous effects of carbon monoxide. It may not be out of order to cite a few incidents to emphasize its dangerous character and call attention to some of the conditions under which it is formed. At this time of the year (January) hardly a day passes that one does not find in his favorite newspaper at least

one account of fatalities due to one or more causes similar to those we shall mention. In summer we see but few such accounts because hot weather prompts people to keep their homes, workshops, garages, etc., open, and heater fires are not in operation.

a. A young man, aged nineteen, is dead in Schuylkill Haven after being suffocated by motor exhaust fumes in his father's garage. His body was found leaning against the door (so rapidly does carbon monoxide act). The chief cause of death was carbon monoxide poisoning, doubtless, though it is likely that carbon dioxide was present in dangerous quantities, and, of course, nitrogen (a suffocating gas) was present.

We have somewhere seen the statement that over 700 persons lost their lives in this country during 1927 in a similar manner. The engine of an auto should never be allowed to run, even for a minute, in a closed garage. The door should be opened wide before the engine is started and not closed until it has ceased running.

b. A man in Overbrook the other day entered his garage to run out his car. He had not yet started the engine when he noticed himself getting faint. He managed to get to the door and soon felt somewhat revived, but has not felt altogether right since. After getting his wits together he remembered that he had started a fire some hours before in a flueless gas stove. The garage was fairly near airtight, the oxygen in the air of the garage was soon used up in large measure by the fire, and what he probably breathed was chiefly a mixture of carbon monoxide, carbon dioxide and nitrogen.

c. A young man of meager means occupies a small room which is heated by a flueless gas stove and lighted by a gas jet; it is a cold night and he decides to stay away from the movies to read a while and then go to bed. He lights the gas in the stove and the gas jet and starts to read; the light is poor and he dozes off; the burning gas soon uses up enough of the oxygen in the room to make the air a non-supporter of combustion, and both flames are extinguished; but the gas flows on through stove and jet, adding carbon monoxide and other gases to the already dangerous mixture in the room. Another lodger on the same floor smells gas when he comes in some hours later, and investigates, only to find the young man dead. He calls the police, who promptly appear and begin to check up. One notes that paper had been stuffed into some of the cracks of the not too tightly fitting window. "Aha! Cracks stuffed up, both gas valves open, fire out, evidences of poverty. Plain case—suicide." We wonder how many unfortunates are an-

nually consigned to suicides' graves through ignorance on the part of officials, and sometimes physicians, of simple chemical reactions. Occasionally the victim is given the benefit of the doubt by the statement, "He is supposed by the police to have accidentally bumped his hand (or foot) against the gas valve," or something similar to this. Gas stoves having no flue connections to the out-of-doors, "hot plates," and even gas lamps and gas-heated smoothing irons are dangerous to use in unventilated rooms, particularly small rooms. Oil stoves and oil lamps are not apt to produce carbon monoxide in quantity, but they use up oxygen rapidly and in unventilated rooms the burning oil tends to produce an increasing amount of smoke or soot (unconsumed carbon). In our time we have seen a number of rooms that had recently been given a thorough accidental smoking from oil stoves, and one instance where the smoking was done by a big Rochester oil lamp, left burning for only a few minutes while the occupant was elsewhere in the house.

d. A few years ago some half dozen Russian prisoners were being transferred from one prison to another in a closed auto sleigh. It was a cold night and the drivers being not altogether "hard boiled," thought to warm the prisoners and turned some of the exhaust gas into the compartment occupied by them. At the end of the journey the prisoners were found to have flown, though their bodies were in the sleigh.

e. It is not necessary to have constricted space to have fatalities from auto exhaust gases. The other day some of the papers told how a woman in one of the western States committed suicide by lying down on the ground near the exhaust of her car. Had the victim been of the opposite sex we would feel disposed to say that some police official has made snap judgment again, but women do not often "get out and get under," so we shall have to accept the verdict as rendered.

f. In some steel mills certain furnaces are heated with burning "producer gas" (rich in carbon monoxide), and, occasionally, accidents have happened, resulting in the escape of quantities of this gas into places where men were working and a dozen or more of them have been overcome from its effects. Up-to-date steel mills where this is apt to happen keep on hand apparatus of the pulmotor type with a plentiful supply of cylinders of oxygen mixed with some carbon dioxide, it having been found that this mixture is more effective than pure oxygen in the treatment of cases of carbon monoxide poisoning.

STREET DANGERS

Because of the large percentage of carbon monoxide in the exhaust gases of automobiles, the large number of motor vehicles in the downtown sections of our large cities, and the poisonous characters of this gas, there has been considerable speculation on the part of thinking people as to the possibilities of harm coming from the breathing of the air around busy street crossings (especially on calm days), or the air of vehicular tunnels like the Holland Tunnel between New York and New Jersey, or of the Fifteenth Street tunnel at our own Broad Street Station, and of the lower floor apartments along busy thoroughfares. It is claimed that babies and young children generally are more susceptible to the ill effects of carbon monoxide than adults, and, certainly, traffic officers would be in more danger than other people. The United States Bureau of Mines and the United States Health Service have recently completed a study of the effects of carbon monoxide, both on the physical and mental makeup of six healthy individuals, and have reached these conclusions:

A concentration of 1 to 4 parts carbon monoxide in 10,000 parts of air breathed for four to seven hours a day every day for sixty-eight days had no effect on the health, appetite, weight, mind or muscle of the people; but symptoms of poisoning (headache, dizziness, faintness) showed with some of them after three to four hours, particularly with the 4 to 10,000 concentration. A concentration of 2 to 10,000 is considered perfectly safe, and, so far as the speaker knows, in no case where the air from places corresponding to those mentioned has been tested has a greater concentration than this been found. Carbon monoxide is slightly lighter in density than air at the same temperature, while the hot gas that comes out of the exhaust pipe of the automobile is still lighter and would thus have a tendency to rise rapidly and correspondingly reduce the probability of dangerous concentrations being formed at street crossings. Besides, the rapid movements of the vehicles has a tendency to create currents which dissipate the gas into the air, and even a moderate breeze is quite sufficient to carry it away. The idling motor would seem to be a far greater source of danger than the motor of a machine moving along the street.

GOOD TRAITS

In our talk thus far we have stressed rather strongly the bad characters of the carbon oxide brothers, and only incidentally touched upon their good traits. Like most humans, they are capable of doing much good in the world, which

good more than compensates for their bad qualities. We shall try to give you just a few.

a. Carbon Monoxide.

This compound has been referred to in our discussion of fuels (particularly anthracite, coke and charcoal) as being formed in the first stage of the combustion of these. It is often purposely produced to be used as a fuel gas where natural gas cannot be obtained, and where solid and liquid fuels cannot be used directly.

What is known as "producer gas" is formed by the partial combustion of anthracite or coke through blowing air through large quantities of the ignited fuel. It is primarily a mixture of nitrogen and carbon monoxide, the latter being the valuable constituent of the mixture. In certain types of furnaces used for the manufacture of steel, and often for heating the so-called "tanks" used in making glass, this gas is largely utilized.

What is known as "water gas" is a mixture (about half-and-half) of hydrogen and carbon monoxide, both of them capable of producing high temperatures when burned. It is generally made by bringing coke to a bright stage of incandescence and then blowing steam through it. The reaction is expressed by the equation:

$$\underset{\text{(Carbon)}}{C} + \underset{\text{(Water)}}{H_2O} \longrightarrow \underset{\text{(Carbon Monoxide)}}{CO} + \underset{\text{(Hydrogen)}}{H_2}$$

Carbon monoxide combines easily with a number of the other chemical elements to form compounds many of which are useful to man. It combines with chlorine to form phosgene ($COCl_2$), a poisonous compound used in the World War in "gas warfare," but capable of reacting with many other compcunds to form substances of benefit to mankind. Urea, a substance now largely used as a fertilizer, is often made by treating phosgene with ammonia.

Carbon monoxide can be made to react with hydrogen to form methanol, formerly gotten chiefly frotm the destructive distillation of wood (hence the name "wood alcohol"), which is a valuable solvent and also capable of being converted into a host of derivatives, some of which have medicinal value, or dyeing value, or find application in the perfume industry, or other industries that favorably affect human life.

b. Carbon Dioxide.

This compound has been referred to as the source of the "fiz" in soda water and other carbonated beverages, and as the cause of the

porosity in bread, cake and many other comestibles. A comparatively new use for it is a refrigerant, taking the place of ice and marketed under such names as "dry ice," "carbon dioxide snow," "carbonice," etc. The solid form is used and heat is absorbed in the vaporization of the solid. It does not pass through a liquid phase as ordinarily used, giving it decided advantages over ice for many purposes. The degree of cold produced is decidedly lower than that capable of being produced with ice and salt. The speaker has been informed that certain manufacturers and distributors of ice cream have practically given up the use of ice, and are using solid carbon dioxide instead, particularly for shipping package purposes. Some of the transcontinental railroads are using it in place of ice for long-distance hauls, particularly as its use does away with the necessity of frequent sidetracking of the refrigerator cars for "re-icing." The speaker has heard of no fatalities attending its use for refrigeration purposes, but sees possibilities of workmen being asphyxiated from the gaseous form through entering unventilated chambers where it has been accumulating.

The annual consumption of soda water (plain or flavored water, saturated with carbon dioxide), especially by Americans, is enormous, yet many people can get along very nicely without it, and millions have never known anything about it; but nothing more disastrous to the human race could happen than the sudden stoppage of the combination of carbon dioxide and water effected by plants. Under the influence of sunlight, plants convert carbon dioxide from the atmosphere and water from the earth into sugars and starch for our food, cellulose for our clothing, wood for our dwellings and furniture, and hosts of other substitutes for our pleasure.

In the hour at our disposal we have tried to give you some light on the characters of two members of the chemical family. We hope that what we have told you will give you a greater appreciation of their usefulness to man than you ever had before, and that what we have said of the unfavorable sides of their respective characters may have so put you on your guard that neither of them will ever be able to harm you.

NOTES ON THE TESTS FOR ISOPROPANOL*

By Henry Leffmann and Charles C. Pines

AN ALCOHOL of the formula C_3H_8O was first isolated and examined by G. Chancel (*C. r.* 1853, **37**, 410). He obtained it from the marc of grapes and recognized that its formula placed it between ethyl and butyl alcohols. At that time the stereoisomerism of organic substances had not been developed and Chancel did not inquire into the exact structure of the molecule.

In 1862, C. Friedel obtained the alcohol by the prolonged action ("einige Tage") of sodium amalgam on acetone. *Annalen,* 1862, **124**, 324. Somewhat later, Kolbe (*Zeits. Chem. u. Pharm.,* 1862, 617; also *Chem. Centr.* 1863, 268) suggested that the name should be "monomethylated ethyl alcohol." Kolbe's views concerning the structural formulas of organic substances were rather peculiar, but he was evidently on the way to a correct interpretation of the data so far obtained.

At present two forms of propanol are definitely recognized. By treatment of some hydrocarbons existing in natural gas and allied products, an impure isopropanol is obtained and is now in large supply. This has given rise to sanitary and pharmaceutical problems similar to those developed about a quarter of a century ago, when a highly purified methanol began to be abundantly produced. The temptation to substitute a liquid, untaxed and freely sold, for one heavily taxed and sold under severe restrictions, is too much for human frailty. Legislation and supervision have practically removed the methanol menace, but the isopropanol problem is, as our French brethren would say, "une question actuelle."

The problem already required solution when the current U. S. Pharmacopœia was in preparation, and a provisional test was inserted in the alcohol rubric. It was soon discovered, however, that the reaction was really due to tertiary butanol and that some commercial samples of isopropanol would not show it. Research has been actively directed to securing a dependable test. The obvious method is to take advantage of the fact that the secondary alcohols yield ketones on

*The text of this communication from the beginning to the description (inclusive) of the Dale-Simonds test, is reprinted from the *Bulletin of the Wagner Free Institute of Science* (1929, 4, 47) with a few minor changes and elisions. The remainder of the text is added as the result of further experiments.

restrained oxidation, while the primary forms yield aldehydes. Development along this line is somewhat complicated by the fact that the detection of acetone in the presence of much aldehyde is not easy, as has been shown recently in some reports of our own experiments.

A detailed method for applying acetone-production to the detection of all commercial forms of isopropanol is described by J. Rae in *Pharm. J.*, 1926, **116**, 630. The procedure is merely to oxidize 10 cc. of the sample by a mixture of 20 cc. of a 1% solution of potassium dichromate with 1 cc. of strong sulphuric acid, distilling 3 cc. and testing this with sodium nitroprussid solution containing strong ammonia and a small amount of ammonium chloride. Inasmuch as acid dichromate keeps indefinitely, we made up a solution of closely approximate strength to that prescribed by Rae and used it in a series of tests. An alcohol of approximately 50% made up by diluting the laboratory alcohol with an equal volume of water was used in all the tests. Rae's method involves superposing the distillate on the nitroprussid solution, a difficult matter when the liquids are of nearly the same sp. gr. To obviate this, we have used a 1% solution of nitroprussid in concentrated glycerol. As the addition of the ammonia-ammonium chloride solution would dilute this glycerol solution very much, we add the former to the distillate. A sharp separation between the liquids is thus obtained without difficulty, and a trace of acetone will show a ring at the contact zone. We have called attention in a previous contribution to the fact that a glycerol solution of nitroprussid keeps somewhat better than a solution in water, and that the latter can be kept in good condition for a long while if not exposed to light.

The following experiments were carried out by Rae's method with the modifications noted. Dr. Charles H. LaWall kindly furnished us with a sample that does not contain tertiary butanol and, therefore, does not react with the mercuric sulphate test. This sample and ordinary isopropanol were used in the experiments. In the following list of experiments and results, A represents the approximately 50% alcohol noted above. The amount of other alcohols added was about 10%.

Sample	*Result of test*
A	negative
A with normal propanol	"
A " isopropanol	positive
A " normal butanol	negative

A	"	isobutanol	"
A	"	secondary butanol	faint ring
A	"	tertiary butanol	negative

Herstein's test. The *Practical Druggist* for November, 1922 (p. 38), contains a communication from Dr. S. Levinson, describing several tests for isopropanol, among which is one stated to have been devised by C. Herstein. It consists in adding to the sample three drops of strong sulphuric acid, 1 cc. of a 30% solution of sodium hydroxide, several cc. of a solution of sodium nitroprussid and from 1 to 2 cc. of glacial acetic acid. Presence of isopropanol is indicated by the development of a dark red solution. We tried this test and found to our surprise that it was positive with the sample of isopropanol that does *not* react with mercuric sulphate and negative to the one that does. Negative results were also obtained with methanol, ethanol, normal propanol and all four forms of butanol. The experiments were carried out as in the cases recorded above, that is portions of the approximately 50% alcohol were mixed with 10% of the other alcohols and the mixtures tested carefully by the method.

Substitution of 1 cc. of 28% ammonium hydroxide for the 1 cc. of sodium hydroxide made no appreciable change in character or delicacy of the test.

We have also experimented with the test developed in the laboratory of the Federal Prohibition Commissioner by Messrs. L. E. Dale and P. W. Simonds. It is as follows:

To 1 cc. of the sample add 1 cc. of a saturated solution of disodium acid phosphate and 3 cc. of saturated solution of potassium permanganate. Warm the mixture, but not to the boiling point, and allow it to stand until the permanganate is completely decomposed. Add 3 cc. of a 10% solution of sodium hydroxide and 1 cc. of a 1% solution of furfural and filter. Add to 1 cc. of the filtrate several cc. of strong hydrochloric acid. This part of the reaction may be aided by slight warming. Isopropanol is shown by a marked color ranging from pink to cherry red. The test depends on the formation of acetone-furfural, and the subsequent strong color reaction of this with hydrochloric acid. We tried the test with both commercial samples of isopropanol (that which reacts with mercuric sulphate and that which does not) and obtained perfectly definite results when a 10% addition was made to the standard dilute alcohol. We find, however, that by reversing the method of adding the hydrochloric acid—that is, by

pouring a small amount of the furfural-acetone solution into several cc. of strong acid—the reaction is more satisfactory. Very small proportions of commercial isopropanol can be recognized by this test, but if comparatively large proportions (*e. g.*, 20%) of propanol, n-butanol, isobutanol or secondary butanol are present, deep red liquids will be obtained which may lead to erroneous inferences. Secondary butanol gives color in much smaller proportions than the other, as might be expected, since it can form a ketone.

G. Reif (*Zeits. Unters. Lebensm.*, 1928, **55**, 382) describes a process especially intended for the detection of isopropanol in brandy. Ten cc. of the sample are distilled from a flask immersed in boiling water, the distillate collected in a receiver cooled by ice. Distillation should be continued as long as appreciable vapor passes over; 1 cc. of the distillate is diluted with 2 cc. of water and 0.3 cc. of this mixture treated with 0.4 grm. of the *Carbo medicinalis* of the German Pharmacopœia. The mixture is filtered through a dry filter, 4.5 cm. in diameter, 5 cc. of a 0.5% alcoholic solution of piperonal are added and then, very slowly to avoid heating, 20 cc. of strong sulphuric acid, mixing thoroughly. About 4 cc. of the mixture are placed in a 50 cc. beaker and heated for a few moments in boiling water. If isopropanol is present, a red or red-brown tint will appear promptly. The addition of 30 cc. of 30% acetic acid will change the liquid to a rose tint that will remain for some time. If no isopropanol is present, the liquid will be brown or greenish brown and the addition of acetic acid will produce only a transient color-change.

The description of this test provokes several questions. Why is so small amount of the distillate taken for test, and what is the exact nature and function of the *Carbo medicinalis?* The latter is, indeed, not clearly described as to source and nature in the current German Pharmacopœia (*Deutsches Arzneibuch*, 6th ed., 1926).

We did not carry out Reif's process, as described, but the suggestion of piperonal as a reagent for detection of acetone led to trying it as a substitute for furfural in the Dale-Simons method, and in other tests, but the substitution did not seem to offer any advantage. The peculiar manipulation of adding 20 cc. of strong sulphuric acid to a small volume of liquid suggested a reversal of the method, as noted in the case of the use of furfural; that is, to pour a small volume of the liquid presumed to contain piperonal-acetone into the strong acid. This was carried out by oxidizing a mixture of 10% of isopropanol in 50% alcohol by Rae's method, and after mixing the distil-

late with a small amount of the alcoholic piperonal solution adding this to 5 cc. of strong sulphuric acid. A very deep red liquid was produced. This color is completely bleached by dilution with water. We tried adding a few drops of the deeply colored liquid to a few cc. of strong acid, by which a lighter but more brilliant tint was obtained.

A procedure is advised by O. Noetzel (*Zeits. Unters. Lebensm.*, 1927, **53**, 388) in which oxidation is done by chromic acid and distillation as to Rae's method. The special feature in the method of detection of acetone. A few cc. of the distillate are mixed with 1 cc. of a 10% solution of ammonium hydroxide, the tube well corked and allowed to stand three hours; 1 cc. of a 10% solution of sodium hydroxide is added, followed by 1 cc. of strong solution of sodium nitroprussid, and acetic acid cautiously added. Acetone is indicated by red, changing to violet; aldehyde by yellow, changing to green. No information is given as to why the ammoniated liquid should stand three hours. Our experiments indicated that the test may be completed at once with satisfactory results.

Summary

It seems to us that with the tests at present available, isopropanol can be detected with certainty even in small amount in commercial alcohol or plain spirits, if the industrial conditions concerning the production of the alcohols between ethanol and the pentanols remain as now, but if any of these intermediate products, other than isopropanol, should be brought to a price that will permit profitable use as an adulterant, the tests at hand will not be sufficiently characteristic, although they will show that some substance other than ethanol or its natural accessory impurities is present. The butanols are not freely miscible with water, but will mix with moderately dilute alcohol and with isopropanol. The Dale-Simonds test is especially convenient, distillation not being required.

Herstein's test seems to be in the same class as that with mercuric sulphate, that is, due to some impurity. If the two forms tested represent the only forms of isopropanol occurring in commerce, the detection of the compound will be easy.

In the distillation work in these experiments we have used with satisfaction and convenience the microdistillation apparatus described by one of us in *Amer. Jour. Pharm.*, 1924, **96**, 506.

Henry Leffmann Chemistry Research Fund.
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MEDICAL AND PHARMACEUTICAL NOTES

SODIUM HYDROSULPHITE: AN ANTIDOTE TO ARSENIC.—It has already been demonstrated (see *Prescriber,* 1927, July, 256) that sodium thiosulphate, whatever may be its virtues in treatment of the dermatitis produced by the organic arsenicals, is valueless as an antidote to orally administered arsenic. The salt is equally ineffective against mercurial poisoning.[1] A closely related salt, sodium hydrosulphite, has been shown, however, to act as an efficient antidote. Bond and Gray[2] (Richmond, Va.), report a series of experiments on dogs, in which this salt effectively prevented poisoning after administration to the animals of 1 c.c. of Fowler's solution per kg. of body-weight. Immediately following the administration of arsenic, sodium hydrosulphite was given in doses of 100 mg. per kg. in the form of a 10 per cent. solution, rinsed down with 25 c.c. of normal hydrochloric acid (36.47 gm. of HCl in 1000 c.c.). The acid accelerates precipitation of subsulphide of arsenic in the stomach. The only objectionable feature is that the salt is liable to cause vomiting, at least in experimental animals. It was found also that unless the antidote was given within five minutes the animal died of arsenical poisoning. Bond and Gray think that in clinical practice there would be greater delay in absorption of the arsenic on account of the presence in the stomach of undigested food. The use of sodium hydrosulphite must not be expected to supplant gastric lavage in practice, but as an adjunct to this procedure the compound may prove effective, particularly in cases where the presence of food in the stomach might embarrass the process of lavage. The immediate administration of sodium hydrosulphite may serve to fix or render unabsorbable the arsenic until lavage can be effected.

[1] That sodium thiosulphate is ineffective in poisoning by mercuric chloride has recently been conclusively shown by K. I. Melville and M. Bruger (*J. Pharm. and Exp. Ther.,* 1929, Sept., 1-8), who show that the length of life of dogs receiving a fatal dose of mercuric chloride cannot be prolonged by subsequent injection of sodium thiosulphate. The diuresis produced by mercuric chloride is not affected; in other words there is no evidence that the mercury is converted into an insoluble sulphide.

[2] Bond, W. R., and Gray, E. W.: Sodium hydrosulphite in treatment of acute arsenical poisoning. *J. A. M. A.,* 1929, June 8, 1919-1920.

Sodium hydrosulphite, $Na_2S_2O_4$, is very soluble in water, sulphur dioxide being liberated in solution. It is used industrially by bleachers and sugar refiners. Its chemistry is somewhat confusing. As its molecule contains no hydrogen, the term hydrosulphite is a misnomer. When its composition was first investigated in 1869 the formula of $NaHSO_2$ was given to it in error. Its scientific name is sodium hyposulphite, but as this name is wrongly given to the thiosulphate ($Na_2S_2O_3$) it is still known commercially as hydrosulphite. (*The Prescriber.*)

FULLER'S EARTH—Terra Fullonica is not at all a usual name for fuller's earth, and it is noteworthy that it occurs in a modern prescription (C. & D., June 8, p. 704), because it is doubtful if it is included in any recent textbook of medicines. Cimolia, terra cimolia, cimolia purpurescens, terra saponaria, smectis, and smectis saponaria have all been employed; but cimolia and terra cimolia have been in more general use than the others from the time of Celsus down to the present day. Pliny has several references to this article, and mentions it under the names of creta cimolia and creta fullonia. The craft of the fuller dates from very early times, and the names of fuller (fullo) was used to designate the operator; it has survived in our English tongue. When it was transplanted here it is not clear, although there is evidence, as shown in the citations in the O. E. D., that fulling was carried on under that name in the eleventh century. One of the earliest instances of the use of the name "fuller's earth" for this substance is perhaps that already indicated in Philemon Holland's translation of Pliny's Natural History, where it is also given the synonym of Tucker's earth; tucker was a dialect word for fuller. Towards the end of his thirty-fifth book Pliny gives an account of the medicinal properties of the article. It was applied for the removal of "foule tettars," "offensive pimples and pushes," as well as for swellings of the feet. The manner of employing it for this last trouble strikes one as being worth a trial. The remedy takes this form: "Incorporate (with the fuller's earth), salpetre (aphronitrum), sal-nitre (nitrum-natron) and put vinegar thereto . . . this cure to be done in the Sunne and that after sixe houres, the medicine be washed off with salt water." The cimolia alba and cimolia purpurescens were official in the Edinburgh Pharmacopœia in the eighteenth century.—Xrayser III., in *Chemist & Druggist*, June, 1929.

HAFNIUM—In jewels the new element, hafnium, may be the solution of the latest jewel mystery. A sparkling deep blue zircon, more beautiful as a gem than the usual brown, greenish or yellow varieties of that mineral, puzzled jewelers and mineralogists when it appeared on the market from Australia, Ceylon and other eastern countries about five years ago.

Dr. George F. Kunz, jewel expert of Tiffany's, who gave the new gem the name "Starlite," believed the mineral to be artificially colored, but knew no such beautiful color resulting from the elements known to occur in zircon. When he set about solving the mystery he learned that, although shipped from various places, the crystals of blue zircon all originated from a single place, near Chantaboon in Siam. There the brown mineral, before being cut, was heated with cyanide of potassium in a closed crucible for some hours, coming out a color ranging from nearly white to deep sapphire-blue, depending on the length of the treatment.

Only the heavier varieties of the mineral, which occurs in an unusual range of weights, will take on the blue color, and Dr. Kunz has found that the heavier kinds of zircon are the ones containing hafnium. He therefore believes that the mysterious color is a manifestation of this little-known element.

Hafnium was discovered in 1923 by D. Coster and G. Hevesy, of Copenhagen, who found that it is a metal similar to zirconium, which is found in the mineral zircon. Although so long unknown, hafnium is by no means rare. It is believed to make up about one-two hundred thousandth of the earth's crust.—(*Science Service.*)

THE MAGIC BOTTLES—Under this heading, "I. B.," in the Sunday *Observer,* of November 17, expatiates on a laudatory reference to English chemists' shops in a book by Theodore Komisarjevsky, "that great artist of the theatre," in whom the spectacle of carboy colored lights in some of our chemists' windows excited an æsthetic and professional thrill. "I. B." rather conjecturally traces the color-carboy to an alchemical source, and invokes the shade and prose of Ben Jonson in support of this far-fetched hypothesis. His quotation is: "Can you sublime and dulcify?" with the comment, "Fit words, dulcification is the first duty of a chemist's window." Here is "I. B.'s" portrait of what he takes to be the typical specimen of our calling:

"The English chemist is true to the national tradition of sane compromise. He dresses himself demurely and his window wantonly. He keeps up the air of learning with his Latinity, but also he feigns the Chaldean and the conjurer with his magic bottles. He would scorn to have English labels on his rows of jars, and he masters the mysterious tongue and the appalling scrawl which go to make up a doctor's prescription. (Or, at least, he pretends to read it, and we drink his interpretation of the mystery without any notable signs of dissolution and destruction.) We like him to have a grave voice and presence, to look at us over gold-rimmed glasses, and to wear a three-guinea Harley Street look, as he whispers with the most confidential concern, 'Will you take it in the liquid or the tabloid form?' So far, so grave. But further the English apothecary refuses to sustain the part of professional adviser. He goes suddenly gay, piles his glittering window with soaps and scents, and offers every service to vanity. The laboratory becomes a bazaar, the pedant is turned to a pedlar with a ribboned pack."

Finally, "I. B." appeals to the chemist to continue his beneficent service as a preserver and an embellisher and enricher of the few remaining elements of mystery and romance in modern town life.

"I see a sad tendency to omit the great coloured vases and to fill the space with a display of dry goods, camera-plates, and such stuff as films are made on. . . . Let us hope that members of the mystery will consider their function as decorators of the town. After all, they are the legatees of the miracle-men. . . . Moreover, where our British towns are grey beyond endurance, their shops are bright and their wares speak of balm and spice of Bagdad and Cathay, amid the piled gloom of factory and warehouse. The druggist who plays the game genie-wise with his magic bottles deserves emendation of a line that glows in every syllable with a mellow and entrancing luminosity—

" 'Gilding pale streets with heavenly alchemy.'

If the chemist of Coketown or Smokeover can do that he fully meets the Jonsonian test of his trade. He sublimes; he dulcifies." —(*Pharm. Jour.*)

NEWS ITEMS AND PERSONAL NOTES

IODINE RESEARCH PROGRAM—Since January 1, 1928, Mellon Institute of Industrial Research, Pittsburgh, Pa., has had in operation a Multiple Industrial Fellowship, founded for the purpose of investigating the properties and uses of iodine. This fellowship, which is sustained by the Iodine Educational Bureau, 64 Water Street, New York, N. Y., is headed by Dr. George M. Karns, formerly a member of the chemical faculty of the University of Illinois. All results of the fellowship studies will be published.

Recently, through an additional appropriation from the fellowship donor, Mellon Institute, acting for the Iodine Fellowship, has made arrangements for the study of certain iodine problems in other institutions that have special facilities for such types of work. On October 7, 1929, a scholarship was founded at the Philadelphia College of Pharmacy and Science by a research grant from the institute. This scholarship—which, for the college year 1929-30, will be held by Mr. L. F. Tice—will have for its aim a broad investigation of vehicles and solvents for iodine, especially for external use in medicine. A large number of new organic chemicals will be studied as solvents with the object of evolving, if possible, a more satisfactory preparation than the alcoholic tincture now in use. The research, for which a definite program has been laid down, will be supervised by Prof. Charles H. LaWall, with the advisory collaboration of other faculty members of the Philadelphia College of Pharmacy and Science and with the direct cooperation of Dr. Karns. The investigational findings of the scholarship will be reported in the literature.

Another phase of the research program includes a grant made on September 26, 1929, to the Pennsylvania State College for a comprehensive investigation—under the dierction of Prof. E. B. Forbes, of the Institute of Animal Nutrition—of the nutritional place and value of iodine in the feeding of live stock. Despite the large amount of work which has been done on the rôle of iodine in metabolism, especially with reference to the thyroid, very little is known regarding the specific dietetic aspects of this element, particularly in the lower animals. Dr. Karns and his co-workers on the Iodine Fellowship of Mellon Institute are cooperating closely with Dr. Forbes and his staff, mainly by preparing standardized feeds. The findings of this research also will be made available to the public, in accordance with the Iodine

Educational Bureau's policy of disseminating to every one interested the results of all investigation made under its ægis.

Mellon Institute is giving consideration to the founding of a research scholarship in a medical school for the purpose of aiding in the solution of incompletely answered questions respecting the utility of iodine in internal medicine. A number of pharmacologists are aiding the institute in determining a program for such pharmacodynamic inquiry.

PHARMACIST WILLS ENTIRE ESTATE TO PHILADELPHIA COLLEGE—Alfred Barth, a graduate of the Class of 1874 of the Philadelphia College of Pharmacy and Science, whose will has just been probated, has made the Philadelphia College residuary legatee of his entire estate.

Mr. Barth conducted a retail pharmacy for many years in Providence, R. I., but more recently has been active in that city as a real estate broker.

The income of the estate is to go to his widow and three other heirs during their lifetime, at the end of which time the entire principal sum is bequeathed to the Philadelphia College as a memorial to Mr. Barth's beloved professor, John M. Maisch, who was internationally famed in his chosen field, materia medica, and as editor for many years of the AMERICAN JOURNAL OF PHARMACY, co-author of the National Dispensatory, and voluminous contributor to scientific literature.

EIGHTH ANNUAL SERIES OF POPULAR SCIENCE LECTURES BEGINS JANUARY 8 AT THE PHILADELPHIA COLLEGE—The Popular Science lectures of the Philadelphia College of Pharmacy and Science, an annual feature there since 1923, will be given again this year in the new building of the college on Wednesday evenings commencing January 8, 1930. Each year an entirely new series of lectures is given. The lectures in years past have attracted wide interest. This widespread interest, which began with the very first series seven years ago, has compelled the Philadelphia College to publish those lectures year after year in bound form, so as to make them available to those who cannot attend the lectures personally.

Recently a fund for publishing these Popular Science lectures in book form was created by an anonymous donor in memory of Thomas

D. Simpson, who, while not himself a pharmacist, was interested in the popular sciences. Volumes containing all of the lectures in each of the six preceding series can be obtained from the AMERICAN JOURNAL OF PHARMACY, Philadelphia, for $1 for each series. Each bound volume contains more than 200 pages.

The subjects and dates of the lectures in the eighth series, which begins January 8, are as follows. Admission is free and the lectures begin at 8:15 P. M.

Wednesday, January 8, 1930, "Seventy Years of Petroleum," Professor F. P. Stroup.
Wednesday, January 15, 1930, "Sound Production and Reproduction," Dr. George Rosengarten.
Wednesday, January 22, 1930, "The Chemist as a Detective," Dr. Charles H. LaWall.
Wednesday, January 29, 1930, "Heat and Cold," Professor Adley B. Nichols.
Wednesday, February 5, 1930, "Ventilation and Comfort," Dr. D. W. Horn.
Wednesday, February 12, 1930, "No More Pain," Professor E. Fullerton Cook.
Wednesday, February 19, 1930, "Iodine, the Element of Doubt," Professor Ivor Griffith.
Wednesday, February 26, 1930, "The Rat Menace," Professor Louis Gershenfeld.
Wednesday, March 5, 1930, "The Chemistry of Electric Lamps," Mr. Paul Q. Card.
Wednesday, March 12, 1930, "Dope—The Story of the Use and Abuse of Opium," Dr. H. C. Wood.
Wednesday, March 19, 1930, "Transparent Life," Dr. Arno Viehoever.
Wednesday, March 26, 1930, "Trees," Dr. Marin S. Dunn.
Wednesday, April 2, 1930, "Inks," Mr. C. C. Pines.
Wednesday, April 9, 1930, "King Cotton," Mr. George Wesley Perkins.
Wednesday, April 16, 1930, "The Ultraviolet Lamp in Chemistry and Criminology," Dr. J. W. Sturmer.

DR. STONER NOW WITH ROCHE—Dr. W. H. Stoner, who was formerly director of the Medical Division Professional Service Department of E. R. Squibb & Sons, has joined the Scientific Department of Hoffmann-La Roche, Inc., of Nutley, N. J., where he assumes the duties of medical director. Dr. Stoner brings to Roche a wealth of experience in the medico-scientific world. His works in the field of bio-chemistry and laboratory methods, basal metabolism and diabetes have been extensively reported and for a time (1921-1926) he was associate professor of bio-chemistry and diseases of metabolism at the Graduate School of Medicine, University of Pennsylvania.

AMERICAN PHARMACEUTICAL ASSOCIATION OFFICERS-ELECT—The Board of Canvassers of the American Pharmaceutical Association, composed of L. F. Bradley, A. C. Taylor and R. L. Quigley, all of Washington, D. C., has announced as a result of the mail ballot for officers of the association the election of the following:

President, H. C. Christensen, Chicago, Ill.

First vice-president, Walter D. Adams, Forney, Tex.

Second vice-president, D. B. R. Johnson, Norman, Okla.

Members of the Council (for three years), H. V. Arny, New York, N. Y.; T. J. Bradley, Boston, Mass.; W. B. Day, Chicago, Ill.

These officers will be installed at the next annual meeting of the association in Baltimore, Md., May 5-10, 1930.

The place of meeting for 1931 will be selected at the Baltimore meeting.

The 1932 meeting will be held in Toronto, Canada, and will be a joint meeting with the Canadian Pharmaceutical Association.

BOOK REVIEWS

MERCK'S INDEX (Fourth Edition). Published by Merck & Company, Rahway, N. J. (Price $5.00—to members of the chemical and medical professions and to students $2.50.)

An encyclopedia for the chemist, pharmacist and physician, giving the names and synonyms; source, origin, or mode of manufacture; chemical formulas and molecular weights; physical characteristics; melting and boiling points; solubilities; specific gravities; medicinal action; therapeutic uses; ordinary and maximum doses; incompatibilities; antidotes; special cautions; hints on keeping and handling, etc., of the chemicals and drugs used in chemistry, medicine and the arts, together with an appendix containing: reactions of the more important alkaloids and glucosides; characteristic reactions of acids, bases, metals, and salts; table of atomic weights; thermometric equivalents; specific gravity tables; metric conversion tables; and abbreviations.

Merck's Index perhaps needs no introduction. It has long since earned for itself a well-merited place in the libraries of pharmaceutical chemists and physicians. Two decades have elapsed since the third

edition. This delay was caused largely by the complete interruption of work on the book in both laboratory and editorial rooms during the World War. Later it was deemed advisable to await the necessary adjustment, in many standards, which followed the merger of Merck & Co. and the Powers-Weightman-Rosengarten Company. The new edition, however, is well worth the waiting.

The intervening years have permitted a most thorough revision and improvement of the work. Its scope has been very much enlarged. Some text included in former editions has had to make way for newer and more important material. Supplementary tables, tests, etc., have been added. At the same time, care has been taken to avoid a massing of matter and detail which would only have defeated the purpose of a condensed, comprehensive, reliable Encyclopedia of Drugs and Chemicals, for the use of members of the chemical, pharmaceutical, medical and allied professions. Particularly does it meet the needs of the student, the apprentice, the young man on the threshold of his professional career. From the background of a rich laboratory experience with Merck's Index the reviewer unhesitatingly recommends it as a real "vade mecum."

AN ELEMENTARY MANUAL OF PHYSIOLOGY FOR COLLEGES, SCHOOLS OF NURSING, OF PHYSICAL EDUCATION AND OF THE PRACTICAL ARTS. By Russell Burton-Opitz, S. M., M. D., Ph. D. 2d edition. W. B. Saunders Co., 1925. 413 pages; 147 illustrations.

The student who attends a college of medicine or pharmacy or law is usually in search of the knowledge essential to the practice of a profession. While a certain understanding of the philosophy of a science is necessary for the intelligent correlation of its facts, emphasis in professional schools is laid on facts rather than theory. In a college of liberal arts, to which the student goes primarily for mental discipline, the facts of science while necessary for a comprehension of its philosophy, are of less import than the apprehension of the basic principles involved. It follows that there are two distinct avenues of approach for the teacher of such sciences as chemistry or physiology, depending on whether they are to be viewed from the utilitarian or the academic point.

Dr. Burton-Opitz has prepared this manual with especial thought of the student at the academic school and consequently stresses the

biologic significance of physiological facts. The book is written in a clear, interesting style, which can be read with understanding by anyone with a fairly extensive vocabulary. Technical terms are unavoidable in a book on a science, but Dr. Burton-Opitz shows a commendable preference for plain English whenever possible. The text is made still more comprehensible by the free use of diagrammatic illustrations.

We can gladly commend this manual to any reader who wishes to acquire some knowledge of physiology as a matter of general information.

H. C. Wood, Jr.

Campbell's Book: A Text Book on Canning, Preserving and Pickling. By Clyde H. Campbell, Consulting and Analytical Chemist; Chemist to Bureau of Foods and Chemistry, Pennsylvania Department of Agriculture.

This work, which is published by the *Canning Age*, 521 Fifth Avenue, New York, is in the unusual format of a folio with a page size approximating 9 by 12 inches. Its more than 200 pages are packed with information valuable not only to the canner and the manufacturer of food specialties, but the book will be found to be an indispensable adjunct to the library of the food law official as well as to the food chemist.

Dr. Campbell has collected the data here assembled during more than twenty years of active service, part of which was as a chemist in the U. S. Department of Agriculture, and part of which was obtained in the industry itself, before he became attached to the Board of Chemistry of the Pennsylvania Department of Agriculture, in charge of the Pittsburgh district.

The contents include complete directions for the canning of fruits and vegetables, the preparation of jellies, jams, crushed fruits, glacé fruits; tomato products, such as pulp, paste, catsup, and Chile sauce; the salting of fruits and vegetables, the manufacture of sauerkraut; the manufacture of various kinds of vinegars; the preparation of many varieties of condiments and sauces, and of mincemeats, plum puddings, table syrups, salad oils and peanut butter.

Complete information is given for large scale production and the work is replete with illustrations of modern labor-saving machinery suitable for use in many of the operations.

In addition to the trade and government standards differentiating between the grades of canned fruits and vegetables and the regulations regarding the sizes of cans, etc., the text frequently contains data concerning the composition of many of the products.

Every chapter contains many formulas for large scale production and the standards of the "Joint Committee on Definitions and Standards" of the American Association of Official Agricultural Chemists are given in connection with each group of products.

There is a very carefully compiled and comprehensive index, and a bibliography of hundreds of titles of books, journals, articles, and Federal and State bulletins.

CHARLES H. LAWALL.